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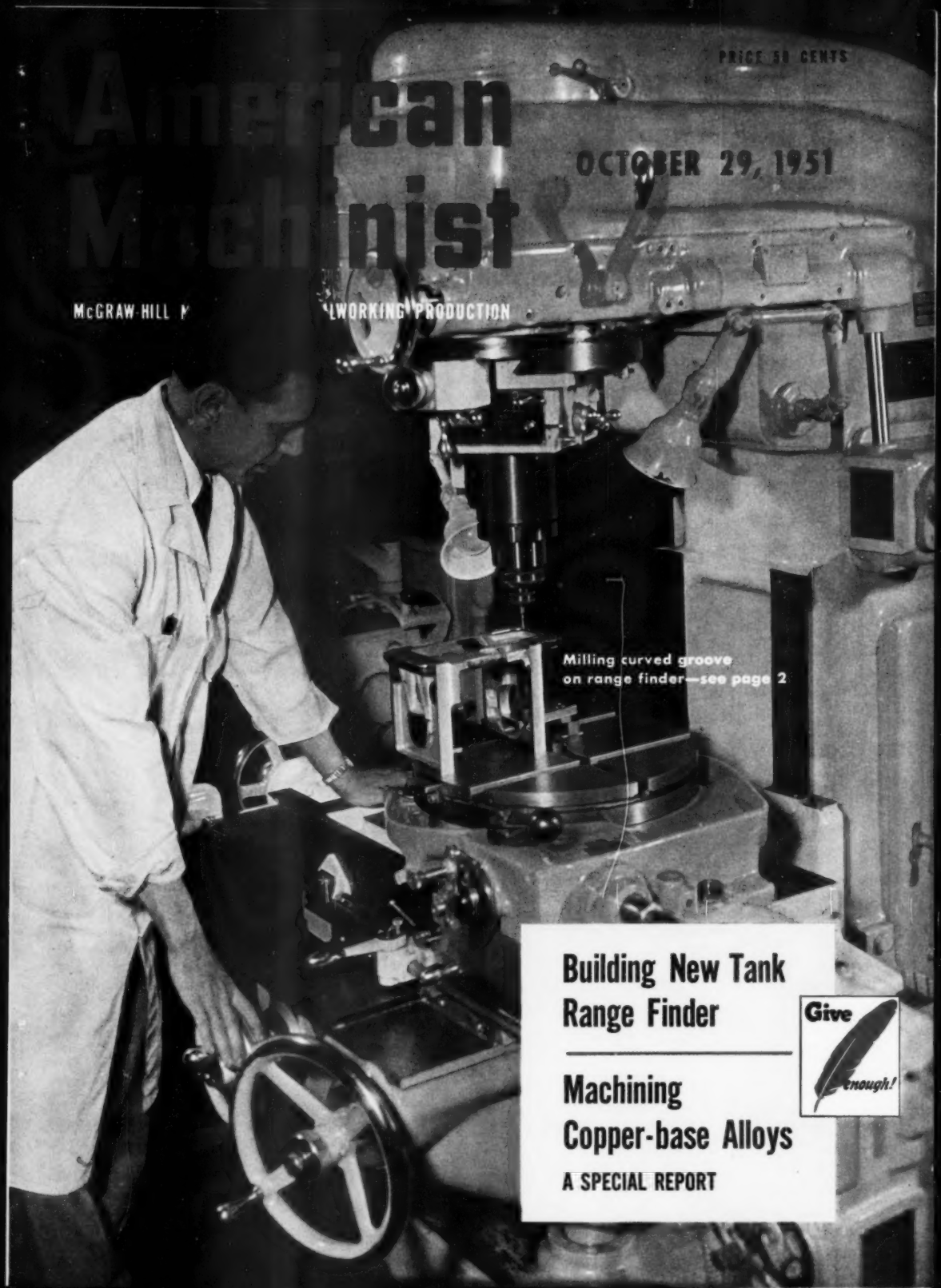
American Machinist

OCTOBER 29, 1951

McGRAW-HILL P

LWORKING PRODUCTION



Milling curved groove on range finder—see page 2

Building New Tank Range Finder

Machining Copper-base Alloys

A SPECIAL REPORT

Give enough!

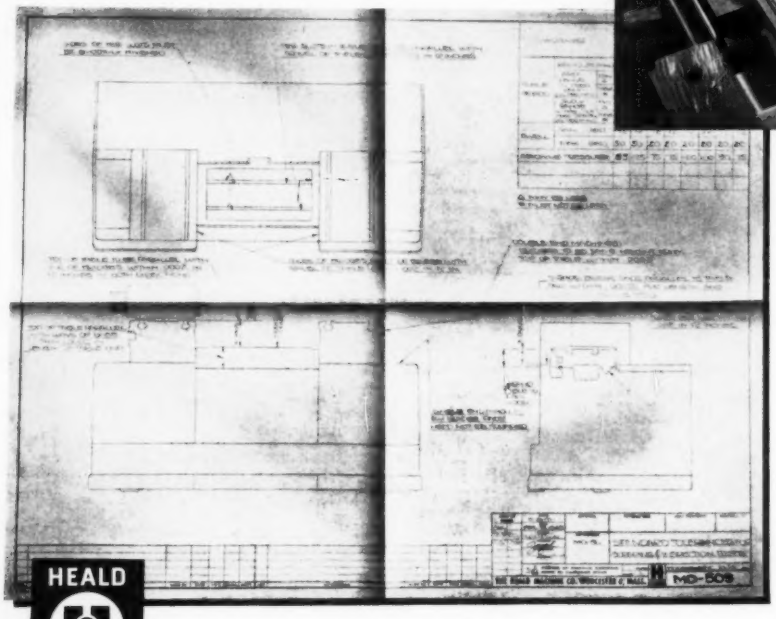
the last .0002 inch is the hardest

...yet no pains are spared to put this extra precision into every Heald machine —so YOU can get more precision out of it

The *best* way isn't always the *easiest*. That's particularly true of the parallelism between the flat and vee table ways and the table pad on a Heald machine. To meet the extremely close manufacturing tolerances that are *standard* for every machine, these table ways are carefully hand scraped by skilled craftsmen. For there is no compromise with *quality* when it comes to building Heald Bore-Matics and Grinding Machines.

True — it means a lot of careful work, and it takes a little extra time. But the results are worth every bit of it TO YOU — in terms of faster, better production, longer machine life, with higher precision and greater accuracy.

Hand scraping puts the finishing touches on the flat and vee table ways of a Heald Bore-Matic.



This blueprint shows the manufacturing tolerances that are *standard* for all Heald Bore-Matics.

HEALD
125 YEARS

Heald machines speed the nations production

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American Machinist

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Chips and QUIPS

Milling Curves . . . Our cover shows a Kearney & Trecker 2D rotary-head milling machine in the model shop of the Fire Control Instrument Group at Frankford Arsenal. The machine is milling a main-housing sealing groove for the super-elevation cam-mechanism of a new range finder recently developed in the Ground Weapons Department. One of the newest machines in the shop, this unit simplified the cutting of rounded corners in the grooves, as the head can be set to produce the required radius directly.

Attractively painted according to modern color-coding practices, the model shop is intended primarily for developmental and experimental work, and it was here that much of the work on the first of the new range finders was done. Several new techniques employed in the manufacture of this instrument are described in our lead article.

Machining Copper . . . Several years ago, we published a Special Report dealing with the machining of copper alloys. Its popularity is attested to by the fact that we no longer have copies available. As a consequence, we present in this issue a new version on how to machine copper alloys by L. F. Spencer of Landers, Frary & Clark. Included are feeds, speeds, cutter angles, and lubricants, subdivided by the three general classes of copper alloys, plus the general information you need to apply the data to your job.

Red Feather . . . Note on our cover the "Red Feather" symbol of the Community Chests, whose annual drives for funds are currently under way all over the U.S. We placed the symbol there to remind you that they need more this year.

Range . . . Glass-to-metal bonding of precision optical elements, injection sealing to make the instrument airtight, and cutting non-circular gears are among the unusual techniques described in our lead article. The first two are, in fact, postwar developments, and the third has been greatly improved by invention of a new machine in 1948. These techniques are used in the new tank range-finder and in other fire-control instruments which will have to be made by metalworking companies not skilled in the manufacture of optical instruments—the optical companies are not large enough to handle emergency load.

Agencies . . . In these days you must find labor where you can. One possible, and frequently inefficiently used, source is employment agencies. John D. Whitmore, who has had considerable experience, describes how to get the most from professional employment agencies.

Will Finds Way . . . J. A. Bell, traffic manager of Canadian Vickers Ltd, shows in pictures the solution of a difficult problem—how to move a 135-ton catalyst regenerator the 15 miles from builder to user. Roadwork and sailing were both involved.

Tool-Wear Causes . . . Milton Shaw and Prescott Smith continue in this issue their series on metallurgical considerations in machining. Their current subject, No. 4, is tool wear and its causes. They show the relationship between welding on the clearance face and the cutting speed, and possible wear acceleration at some speed because the tool matrix loses hardness relative to the workpiece matrix.

Glass Plastic . . . Fiber glass, glass wool, and plastic are being used by major aircraft companies to conserve aluminum and steel in mold making. In this issue is a round-up of practice at North American, Consolidated Vultee, and Boeing in the use of glass plastic.

Coming . . . *American Machinist* for Nov. 12 will include the third of our series of Special Reports for training employees. This one details with inspection tools. There will also be a feature article on talented tooling with carbides, another on sharpening peripheral milling cutters, and others on phenolic molding powders, getting government contracts, new uses for hot air, and a further installment of the Shaw-Smith series.

MARS TO VULCAN . . . Jay W. Courage, newest of our assistant editors, is a 6-ft 2-in., 30-year-old veteran (captain, NSAF). He had three years towards his ME at Columbia and U. of Conn., drafted for Pratt & Whitney Aircraft for two years, then joined the Air Force. Seven years of active duty, five of it in Europe as twin-engine pilot and communications officer, preceded by radio and radar specialization, brought him back here in 1949. The past two years were spent in drafting and design for Wulff Engrg, P. R. Mallory and Chrysler Airtemp. He joined AM six months ago, assisting with news and descriptions of new shop equipment.

When your straight bevel gear production requires more equipment, the No. 7 Revex Rougher gives you rapid, close roughing of tooth taper and profile shape more rapidly . . . frees your No. 14 Straight Bevel Generator from roughing so that full production time can be used for finishing . . . leaves little metal for finishing tools to remove . . . tools last longer, thus providing a superior quality in the completed gear.

ROUGHING

PAIRED FOR PRODUCTION

The Gleason No. 14 Straight Bevel Generator is completely universal for roughing or finishing. When production requirements increase, it is also the ideal machine for finishing only. Production schedules for producing quality Coniflex gears can easily be maintained when these two machines are paired for high production.

FINISHING

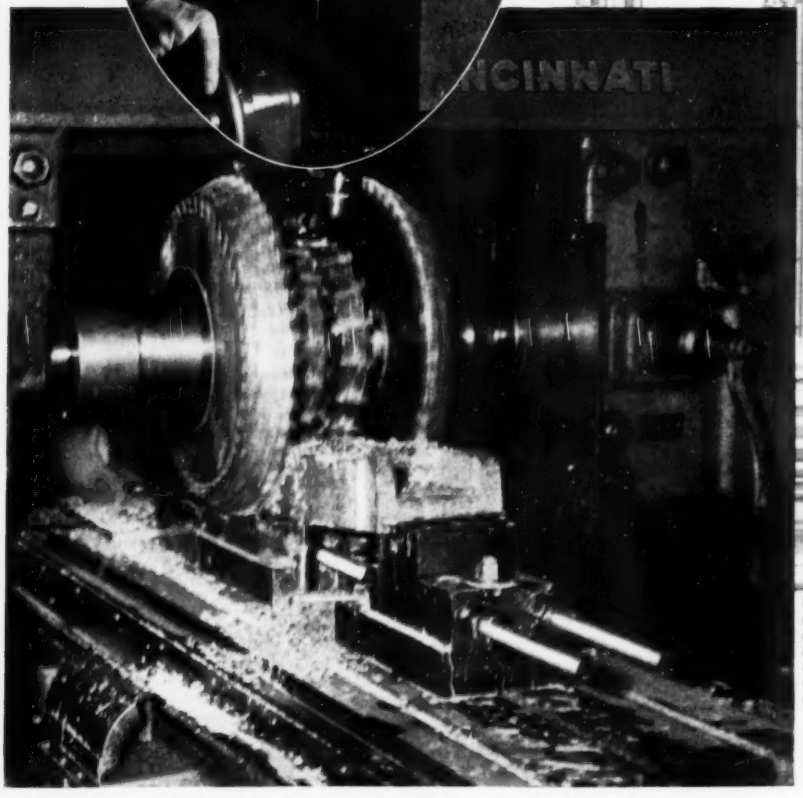
BUILDERS OF BEVEL GEAR MACHINERY · GLEASON · FOR OVER EIGHTY-FIVE YEARS ·

GLEASON WORKS

1000 UNIVERSITY AVENUE · ROCHESTER 3, NEW YORK

REMINDER FOR your expansion

To maintain high cutting efficiency for your die-sinking operations, you will need CINCINNATI Monoset Cutter and Tool Grinders to sharpen the cutters, and perhaps make some of them.



Large gangs of cutters, correctly sharpened, give you a chance to run the machine at its maximum capacity. For cutters of this type, you need CINCINNATI No. 2 Cutter and Tool Grinders.

program 30: 4: 1

MILLING MACHINES • No. 2 CUTTER GRINDERS • MONOSET

CINCINNATI No. 2 Cutter and Tool Grinder. Catalog No. M-1734.

CINCINNATI Monoset Cutter and Tool Grinder. Catalog No. M-1591-1.

Thirty milling machines use a lot of cutters. To keep them working efficiently, you will need at least four No. 2 Cutter Grinders and one Monoset. The 30:4:1 ratio is for the average shop using both sintered carbide and high speed steel cutters. For high speed steel cutters alone, the ratio can be as high as 40:4:1; for sintered carbide cutters alone, it can be about 20:4:1. These figures may serve as a reminder that your production schedules will bog down without an adequate supply of accurately sharpened cutters. Of course, the best cutter grinders you can buy are CINCINNATIs. Reasons why are numerous.

CINCINNATI No. 2 Cutter and Tool Grinder—Control levers at two front and two rear operating positions . . . fixed operating height for all cutters sharpened with standard equipment . . . cartridge type antifriction spindle mount, lubricated for life, easily replaced . . . antifriction ways for table slide, replaceable if worn after years of service.

CINCINNATI Monoset Cutter and Tool Grinder—for sharpening small cutters, and making them from solid bar stock . . . completely universal, for grinding straight, taper, convex, concave, and ball nose cutters . . . built-in lead mechanism . . . a fine assistant for the No. 2 Cutter and Tool Grinder.

Check the ratio today of your milling machines versus cutter grinders. It may save you headaches later on. And remember, if you have only a few milling machines, you still need a No. 2 Cutter Grinder . . . you can assign other work to it. Now, while you're thinking about cutter grinders, ask for the Cincinnati literature.

THE CINCINNATI MILLING MACHINE CO.
CINCINNATI 9, OHIO

CINCINNATI

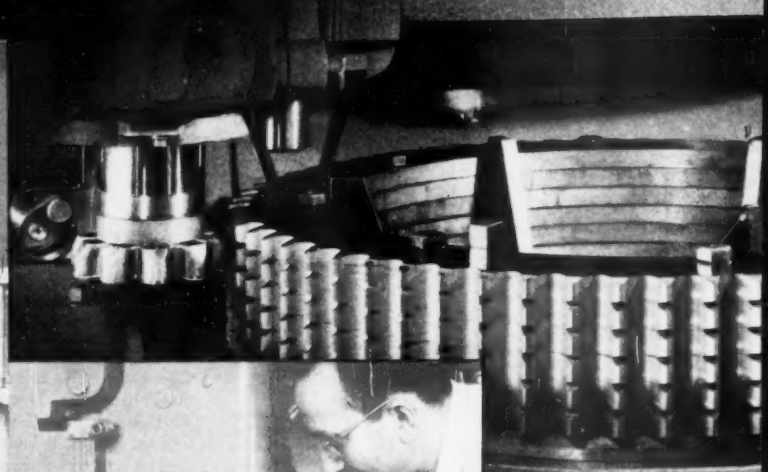
CINCINNATI

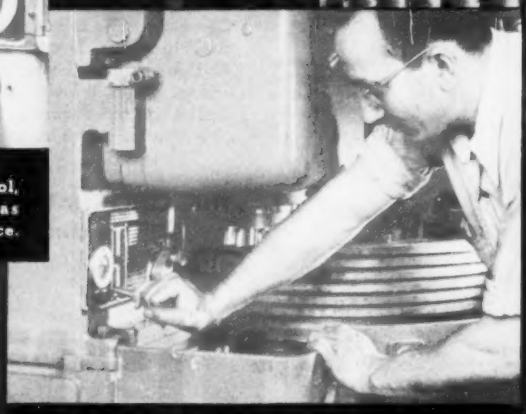
MILLING MACHINES • CUTTER SHARPENING MACHINES
BROACHING MACHINES • FLAME HARDENING MACHINES
OPTICAL PROJECTION PROFILE GRINDERS • CUTTING FLUID

Quick Changes

STROKES PER MINUTE Simple shift levers change cutter-strokes-per-minute in seconds. 12 changes available.

DEPTH OF CUT Dial control, graduated in thousandths, is as quickly adjusted, and locked in place.



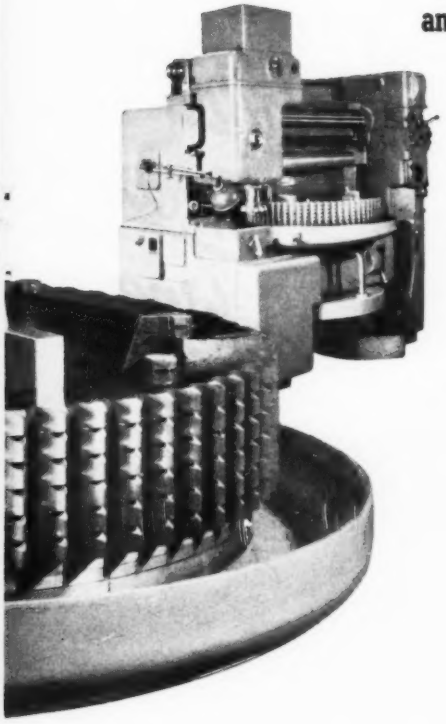


ROTARY FEED A quick change gear-shift selection of 4 rotary feeds—with 8 (or more) additional feeds by changing two "pick-off" gears.

..in Feeds and Speeds

A SPUR TO TOP EFFICIENCY

On Short-Run Production the 36-Type Gear Shaper's 'Gear Shift' Controls make it simple and easy to rough and finish at maximum feeds and speeds.



The simplicity of control and operating convenience of the 36-Type Gear Shaper actually encourages record performance on different-sized blanks—as here pictured on sprocket cutting at Silent Hoist & Crane Company's Brooklyn (N.Y.) Plant. . . . All in all it takes no more than 25 seconds to change settings for (1) cutter strokes per minute (2) depth of cut and (3) rotary feed.

←Note how the blanks (for 7/8" roller chains) are stacked 6-high, to take advantage of the full 6 inch face width capacity of the 36-Type Gear Shaper. Typical feed and speed data for roughing and finishing cuts follows:

1.5" C. P. Sprockets	1st Roughing Cut		2nd Roughing Cut		Finishing Cut	
18.524" O.D.						
SAE 1040, 37 teeth,	Depth cut	.590"	Depth cut	.150"	Depth cut	.115"
7/8" face width,	Feed	.027"	Feed	.027"	Feed	.0408"
6 pieces per load	Strokes p.m.	41	Strokes p.m.	41	Strokes p.m.	50
32.867" O.D.						
SAE 1040, 67 teeth,	Depth cut	.590"	Depth cut	.150"	Depth cut	.130"
29/32" face width	Feed	.021"	Feed	.021"	Feed	.021"
6 pieces per load	Strokes p.m.	41	Strokes p.m.	41	Strokes p.m.	41

The same advantage in quick flexibility of control applies irrespective of the diameter and pitch of the work—with the same overall advantages of low production costs and cutter economy. . . . Precision quality of the work done can be held to any desired limits.

It's time to modernize! Your requirements in heavy duty gear cutting will profit by early investigation of the 36-Type Fellows Gear Shaper. For a catalog or a call, get in touch with the nearest Fellows Office.

Fellows

THE FELLOWS GEAR SHAPER COMPANY • Head Office and Export Department • 78 River Street, Springfield, Vermont
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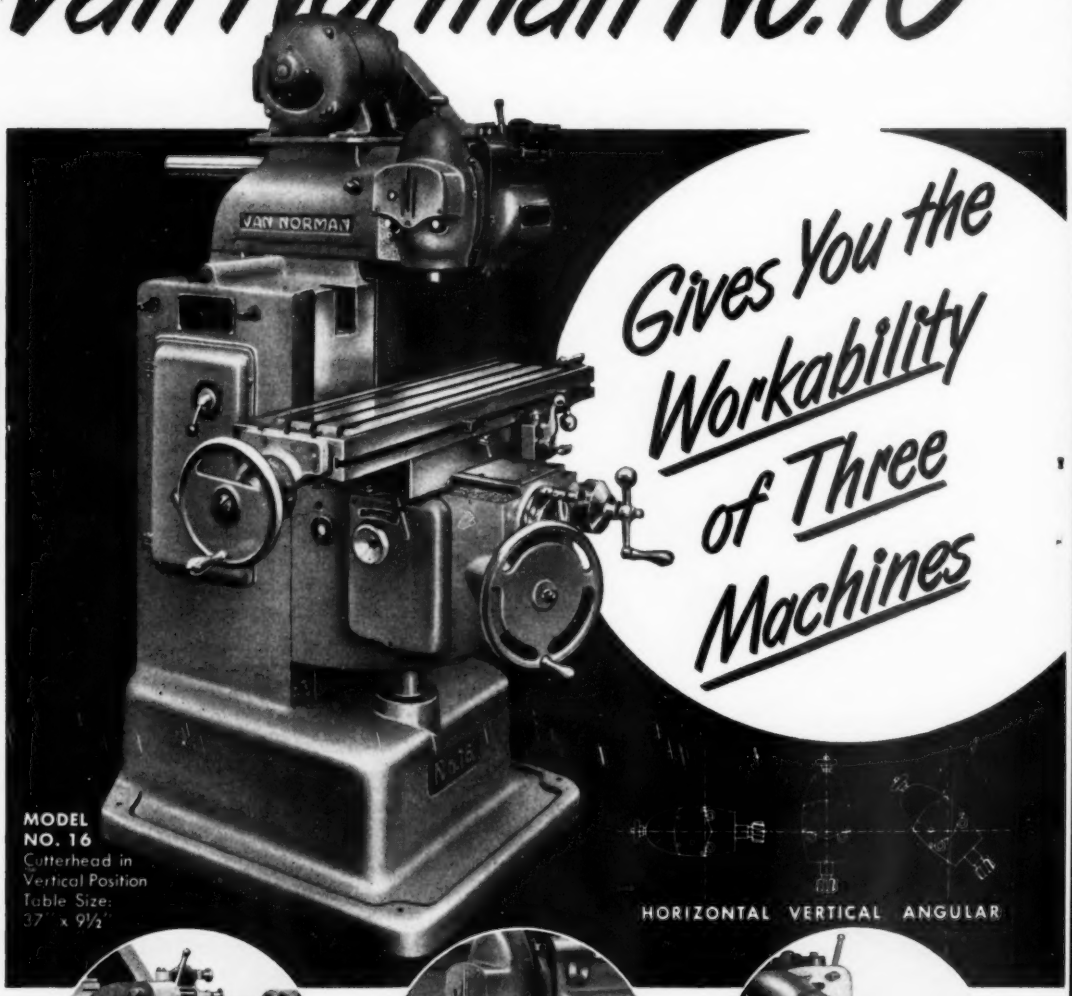
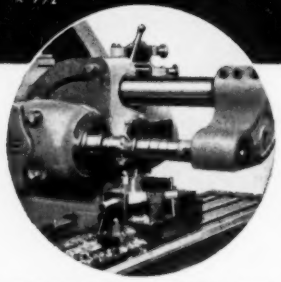
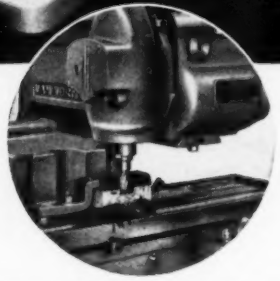
Van Norman No. 16

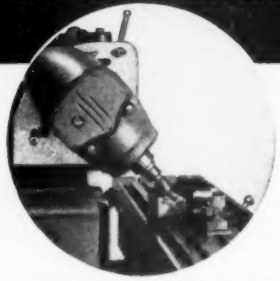

VAN NORMAN
Gives You the Workability of Three Machines
MODEL NO. 16
Cutterhead in Vertical Position
Table Size: 37" x 9½"
HORIZONTAL VERTICAL ANGULAR



With the cutterhead locked in horizontal position, the No. 16 is used for horizontal milling operation. Hardened stop set at factory assures positive 0° setting.



Illustrated, the No. 16 is used for a vertical milling operation. Permanently fixed hardened stop permits easy, accurate positioning of the cutterhead at 90°.



Here the adjustable cutterhead is set at 45° angular milling position. Horizontal, vertical, or angular milling all are easily performed on the No. 16 Miller.

Ram Type Miller

Here's a miller so versatile that it enables you to perform any and every milling job from horizontal to vertical . . . simply by positioning the adjustable cutterhead which is mounted on a movable ram. Why do you benefit . . . because with this one machine you have the work range of several single purpose millers. This enables you to keep the Van Norman miller working all the time . . . also many jobs can be carried through to completion without changes in the workpiece setup — saving time and reducing errors.

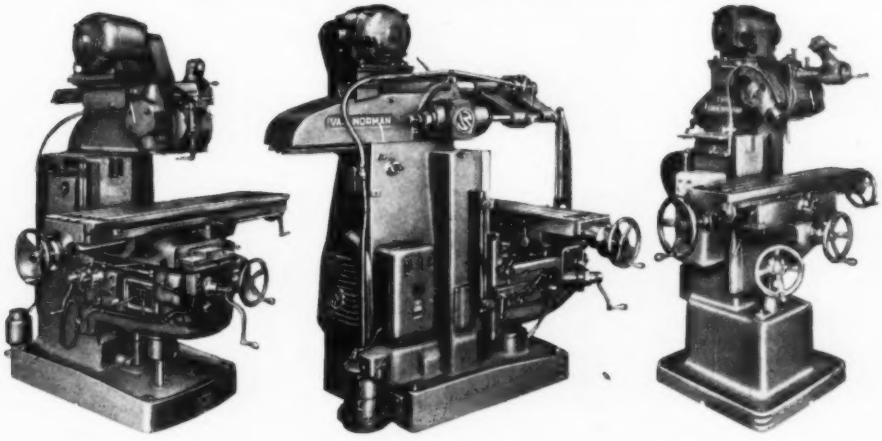
The Van Norman No. 16 Ram Type Miller gives you these additional advantages —

Conveniently grouped controls in front of knee makes operations easy. Power feeds are selected with a quick change feed selector. Large, easy-to-read dials.

Built-in electric controls simplify operation. Single lever selector controls spindle, feed and coolant. Push-button, on front of knee, starts and stops motors as pre-selected.

Rugged base and column, massive cutterhead, large ram and heavy knee, saddle and table assembly provide maximum rigidity and long life accuracy.

OTHER VAN NORMAN RAM TYPE MILLERS THAT REDUCE PRODUCTION COSTS



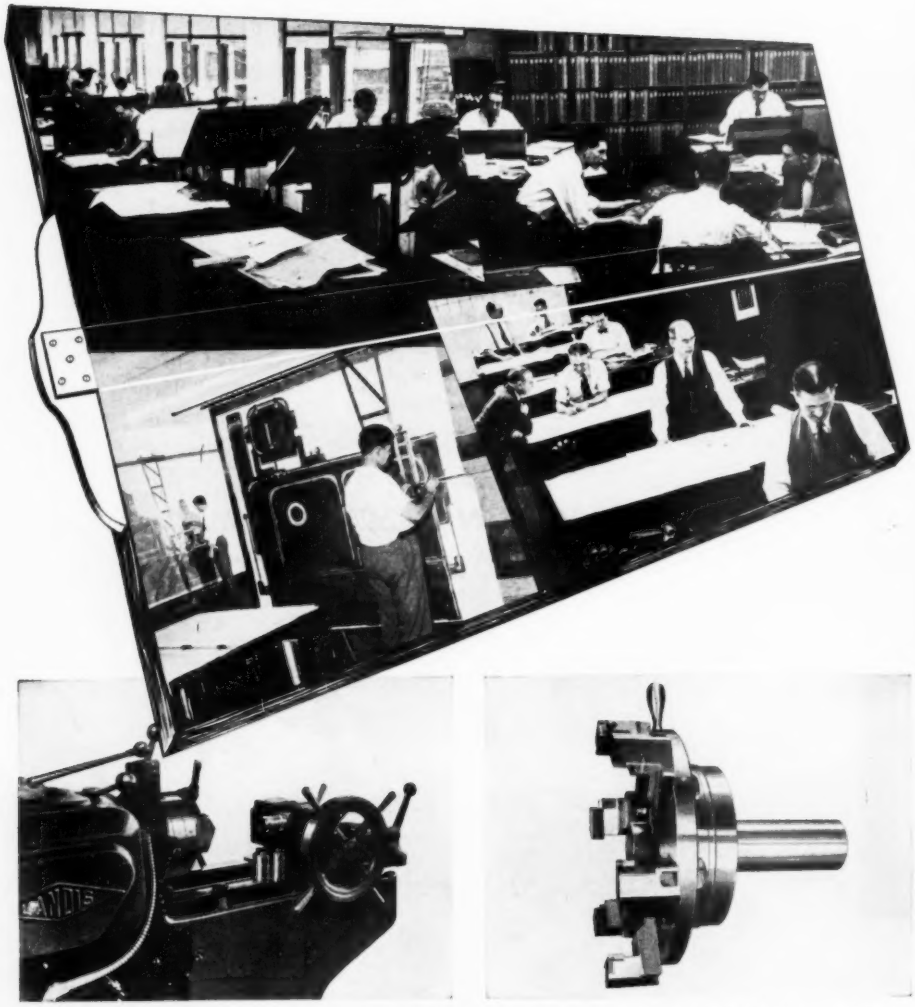
MODEL NO. 38
Cutterhead in Vertical Position
Table Size: 64" x 14"

MODEL NO. 22L
Cutterhead in Horizontal Position
Table Size: 45" x 10"

MODEL NO. 12
Cutterhead in Angular Position
Table Size: 37½" x 9 3/16"

VAN NORMAN COMPANY
SPRINGFIELD 7, MASSACHUSETTS

A COMPLETE *Thread*



A 1½" Single LANDMACO Machine equipped with special work holding fixture for threading adapter sleeves.

A Special Die Head (LANDMATIC 40AXX) designed and built to thread valve seat rings up to diameters of 14¾".

● *THE WORLD'S LARGEST EXCLUSIVE MANUFACTURERS*

Engineering Service

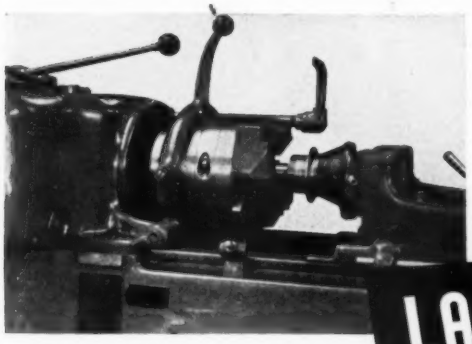
- **PRODUCT DESIGN**
- **PROCESS DEVELOPMENT**
- **ALL TYPES OF THREADING EQUIPMENT**
- **SPECIAL APPLICATIONS**

New and improved products often create unprecedented threading problems—both in design and production. Realizing this, we offer all manufacturers the help of our Thread Engineering Service in efficiently and economically solving their Thread Problems.

The difficulty may be in designing a thread which will function properly as an operating part, or in producing a thread already designed. Whatever the problem our Engineering Department is ready to help with advice and assistance—or to undertake the solution alone.

After examining all phases of the problem, the necessary recommendations will be made on basic Thread Design, the production process, and the Threading Equipment that should be used. For example, often a difficult Thread Production problem can be solved with a slight change in basic Thread Design. Occasionally, a job is so unique that special equipment is needed—three such Special Equipment Applications developed by our Engineering Department are illustrated below.

Whatever your Thread Problem, use our THREAD ENGINEERING SERVICE. Hundreds of manufacturers have been able to perform difficult threading operations efficiently and economically with Landis Threading Equipment. The years of Thread Experience and Engineering Know-How that has brought LANDIS to the fore in Thread Generating is at your service. May we help you?



A 1½" Single LANDMACO Machine equipped with special carriage front for threading axle housings.

OF THREAD GENERATING

LANDIS Machine COMPANY

WAYNESBORO, PENNSYLVANIA

EQUIPMENT

IMPROVED LANDIS TOOL GRINDING METHOD

by grinding TWO diameters in ONE operation

LANDIS TOOL 10" x 36" Type CH Plain Grinder with special tooling:

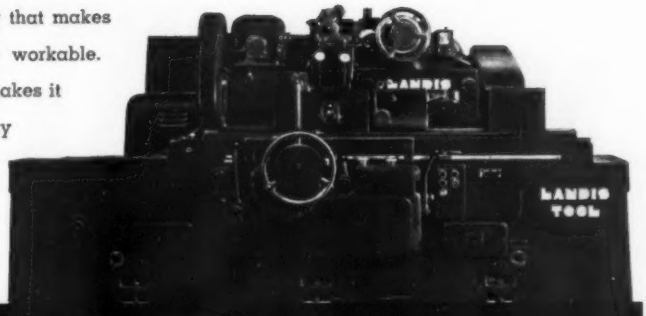
❶ **LATERAL LOCATOR** to prevent grinding wheel from striking flange on rapid infeed.

❷ **DOUBLE DIAMOND HOLDER** allows operator to dress both wheels at once in exact relation to each other.

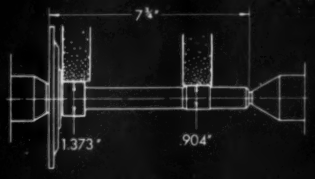
LANDIS TOOL COMPANY / WAYNESBORO, PA. / U. S. A.

STEPS UP PRODUCTION 74%

LANDIS TOOL EXTRA DIAMETER WHEEL SPINDLE provides the rigidity that makes this spaced wheel assembly workable. Minimum spindle deflection makes it easier to maintain concentricity and finish of two diameters because both are ground at the same time.

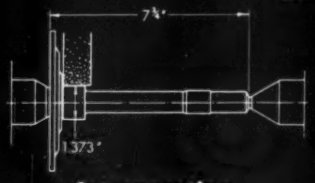


NEW METHOD
Production—125 Complete Shafts Ground Per Hour

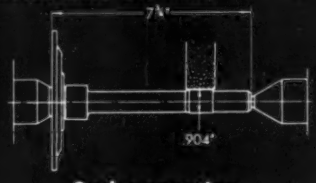


Stock removal .003" to .012"
Finish 15 micro inches maximum
Limits .0005"

OLD METHOD
Production—72 Complete Shafts Ground Per Hour
Same stock removal, finish and limits



1st operation



2nd operation

128

If you have a precision grinding problem, we will make recommendations and production estimates on the basis of your blueprints.

LANDIS TOOL
Precision Grinders

INVITATION

TO EVERY USER OF MACHINE TOOLS

Giddings & Lewis' 5-point "Job Analysis Service" takes the guesswork out of buying heavy machine tools . . works for you and with you to solve big or complex machining problems . . increases production . . reduces machining costs

GIDDINGS & LEWIS

Table Type Horizontal Boring Machine
Floor Type Horizontal Boring Machine
Planer Type Horizontal Boring Machine
Hydro-Open-Side Planer

1 **COMPLETE STUDY OF YOUR JOB OR JOBS** G&L Job Analysis Engineers, working with your engineers, analyze your individual job requirements by: (1) number and size of parts to be produced, (2) number and kind of operations needed, (3) tolerances and finishes required.

2 **DETERMINE MOST EFFICIENT MACHINING METHOD** Taking into consideration the individual machining requirements of the job, G&L Job Analysis Engineers choose the most efficient machining method. G&L engineers can give an unbiased opinion because G&L builds a complete line of sizes and types of planers, planer-millers, vertical boring and turning mills and horizontal boring, drilling and milling machines . . . plus a complete line of accessories and tooling for these machines.

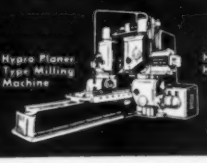
3 **SELECT THE SIZE, KIND AND TYPE OF MACHINE** The machining method now determined, G&L Job Analysis Engineers — using your specific production and work requirements — recommend the exact size, kind and type of machine that will do the job most efficiently.

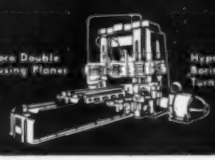
4 **PLAN YOUR OPERATIONS** After the selection of the most efficient machine to fit your needs, G&L Job Analysis Engineers plan a sequence of operations that will (1) minimize number of setups and setup time, (2) use modern cutting tools to best advantage, (3) take full advantage of the machine working ranges and capacities, (4) keep operator fatigue to a minimum.

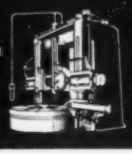
5 **RECOMMEND (AND DESIGN IF NECESSARY) THE TOOLS TO USE** If conditions warrant, G&L will recommend the standard machine accessories, arrangements and tools you can use to make your equipment more productive — more versatile in application. If special equipment is needed, it will be designed to agreed specifications and made a part of your order.

Write G&L or their nearest representative today. Get the facts on your needs — your problems. Get a G&L unbiased Job Analysis to help you. Don't hesitate — there's no obligation . . . AND DELIVERY MAY BE BETTER THAN YOU THINK!

MACHINE TOOL CO.


Hypro Planer Type Milling Machine

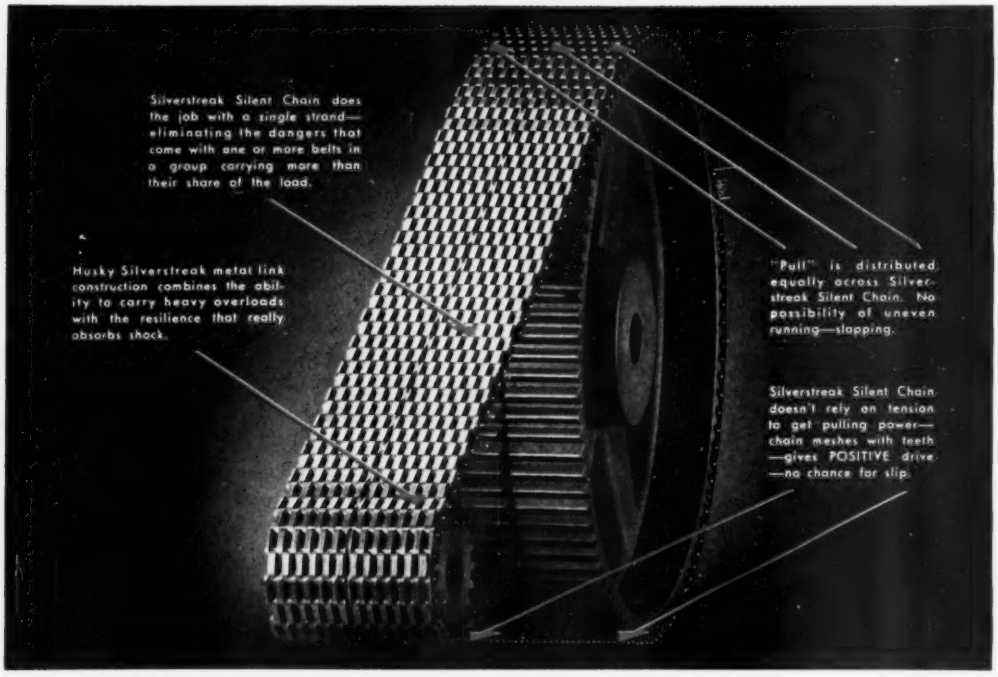

Hypro Double Housing Planer


Hypro Vertical Boring and Turning Mill

G&L HYPRO

FOND DU LAC
WISCONSIN

Get full rpm transmission...


Silverstreak Silent Chain does the job with a single strand—eliminating the dangers that come with one or more belts in a group carrying more than their share of the load.
Husky Silverstreak metal link construction combines the ability to carry heavy overloads with the resilience that really absorbs shock.
"Pull" is distributed equally across Silverstreak Silent Chain. No possibility of uneven running—slapping.
Silverstreak Silent Chain doesn't rely on tension to get pulling power—chain meshes with teeth—gives POSITIVE drive—no chance for slip.

LINK-BELT Silverstreak Silent Chain Drives

Slip-proof
Slap-proof
Shock-proof

TAKE the proven road to increased production — through the best in high-speed power transmission. You'll find Link-Belt Silverstreak Silent Chain Drives are 98.2% efficient. With normal maintenance, you have a *positive* drive that runs for years and years.

And note this important point — on extremely short centers Silverstreaks lose none of their efficiency. What's more, reduction ratios as high as 10-to-1 are frequently used. Both of these Silverstreak features save you valuable space.

One test will prove to you why thousands of production-minded engineers have standardized on Link-Belt Silverstreak Silent Chain Drives.

LINK-BELT

12,200

SILVERSTREAK SILENT CHAIN DRIVES

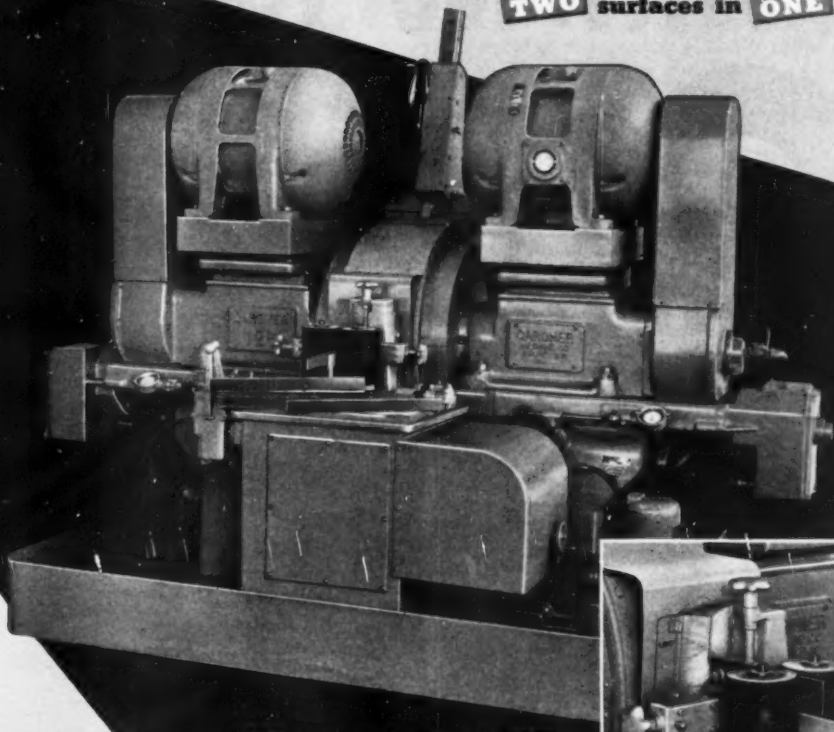
LINK-BELT COMPANY: Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Springs (South Africa). Offices, Factory Branch Stores and Distributors in principal cities.

GARDNER

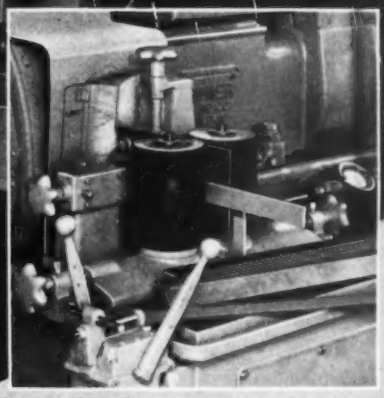
precision disc **Grinders**

13 Feet Per Minute Parallel Face Grinding of Steel Strips

Production increased by grinding TWO surfaces in ONE operation



480 pieces per hour—up to .015" over-all stock removal, limits .002" for uniformity, .001" for parallelism on Gardner 125-26" Double Disc Precision Grinder.



Hand feed to power-operated adjustable roll feed-thru fixture.

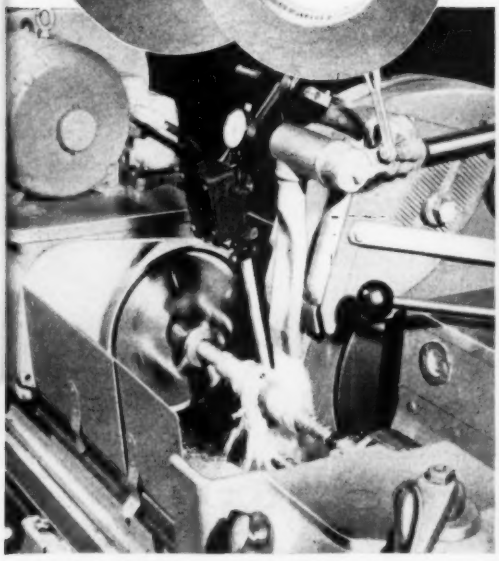
Request bulletin No. 12-7.

10-8M

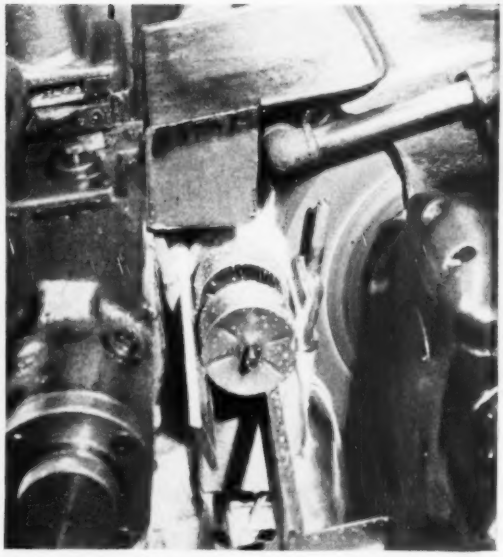
GARDNER MACHINE COMPANY

410 East Gardner Street • Beloit, Wisconsin, U.S.A.

Protect YOUR O. D. GRINDING INVESTMENT with Norton Wheels



Cylindrical grinding small shafts on a production basis.



Plunge-cut centerless grinding of textile machine pulleys.

NORTON
ABRASIVES

Making better products

Buying machines for O.D. grinding — cylindrical or centerless — is a sizable investment, to which you give a lot of serious thought. But remember:

No chain can be stronger than any of its links — and no grinding machine can be more efficient than its grinding wheels.

That's why it will pay you to weigh every condition carefully in your selection of the right grinding wheel. Because without the *right* wheel the costliest grinding equipment will not pay off for you as it should in more production at lowest possible cost.

Then consider this:

No matter what your O.D. grinding jobs are, Norton makes wheels that are exactly right for them. And your Norton Distributor is ready to tell you exactly which wheels you need.

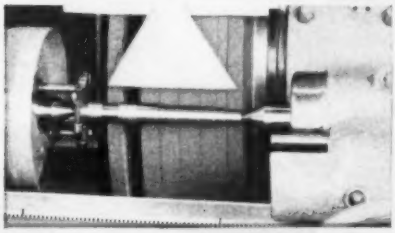
Norton Safeguards for Lower-Cost Grinding

Norton Abrasives, ALUNDUM* (fused alumina) and CRYSTOLON* (silicon carbide) are made in a variety of types and grain sizes for best results on every material handled in cylindrical or centerless grinding.

Norton Bonds, vitrified, resinoid, shellac and rubber are available for cool, free cutting action, extra long wheel life and just the finish you want.

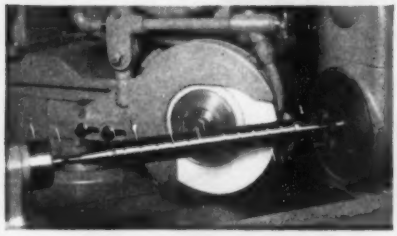
Norton Service includes the most comprehensive applicational aid in the field. In practically every case your Norton Distributor can quickly tell you the correct sizes and types of wheels to use. And if your problems are unusual, he can call on a Norton Abrasive Engineer to give you double assurance of the right wheel for every job.

These O. D. Grinding Machines Are Paying Off...WITH NORTON WHEELS



Wheels *must* be uniform in this cylindrical setup for grinding seven diameters at once.

Through-feed centerless grinding gives high production.



Cylindrical shoulder grinding, with wheel head swiveled to 45° angle.

Plunge-cut grinding to a shoulder in a centerless machine.

Test Your I.Q. on O.D. Grinding

How many of these questions on cylindrical and centerless grinding can you answer correctly?

- *What is the usual range of wheel speeds in these types of grinding?*
- *What conditions prevent wheels from cutting freely?*
- *What are the causes of chatter marks?*
- *When should a filter be used in the coolant system?*
- *What adjustments can you make if a wheel is acting soft? . . . if it is loading or glazing?*
- *What factors govern the choice of abrasives, grain sizes and bonds in wheels for O.D. grinding?*

You'll find answers to these and many other everyday questions on O.D. grinding applications — together with convenient selection charts for your general guidance — in this handy illustrated booklet. Ask your Norton Distributor for *The A.B.C. of O.D. Grinding*, or write direct for Form 2006. NORTON COMPANY, Worcester 6, Mass. Distributors in all principal cities.

to make other products better

*Trade-Marks Reg. U. S. Pat. Off. and Foreign Countries

HOW TO SPEED UP TRAINING OF

MILLING MACHINE OPERATORS

Kearney & Trecker Visual Training Aids can

- Save Time Training Operators
- Help Train Supervisory Personnel
- Improve Vocational School Machine Shop Courses

As a service to industry and education, Kearney & Trecker offers three popular visual aids to complement your training of milling machine operators.

It's no wonder the demand for these visual aids is big. They help you train operators faster . . . do a more complete job. They help you do the kind of training that saves money out in the shop—speeds up schedules and minimizes costly mistakes.

We urge you to send for these aids now while we still have an ample supply. Look over the descriptive material below and send for the ones that can help you.

● **FILM COURSE.** We will loan you, without charge, a complete sound-slide, five-part training film (in color) which deals with good machine tool practice. Special emphasis on the use and purpose of milling machines. Complete with instructor's guide.*

● **ELEMENTARY HANDBOOKS.** Kearney & Trecker's MILLING PRACTICE SERIES of booklets are highly popular with teachers, students and machine operators alike. Book I, "The Right and Wrong in Milling Practice," covers operation of the milling machine including job setup, taking the cut, selection and care of cutters, general housekeeping and safety precautions.

Book II, "The Milling Machine and Its Attachments" covers the principles of modern milling machine design. Attachments and construction and their basic uses are covered also.

The nominal charge of 50¢ each for Books I and II is many times repaid with the help you get from these simple, dramatic presentations of a highly technical subject. The remittance should be made out to Kearney & Trecker Corp., Milwaukee 14, Wis. Send check or money order. No C.O.D.'s or stamps please*.

● **POSTER STUDYVIEW OF UNIVERSAL STYLE MILLING MACHINE.** This big 40" x 60" color studyview of a universal milling machine gives the beginner in shop practice a clearly defined illustration of the machine, its basic construction and the basic elements of operation and maintenance. There is no charge.*

*All applications for visual aids should be made on official company or school letterhead. If coupon is used, your name and title should be submitted together with an official letterhead. Trainees can make individual purchases of Books I and II without official letterhead. Instructors can make group purchases of Books I and II as desired.

Kearney & Trecker Corp., Milwaukee 14, Wisconsin

Please send me:

- ☐ Application for loan of sound slide training film. No charge.
- ☐ Book I, "Right and Wrong in Milling Practice". 50¢ enclosed.
- ☐ Book II, "The Milling Machine and Its Attachments". 50¢ enclosed.
- ☐ Poster Studyview of Universal Style Milling Machine. No charge.

I am enclosing my official company letterhead.

Name_____

Title_____

Company_____

Address_____

YOU CAN MACHINE IT BETTER, FASTER, FOR LESS WITH WARNER

All Lufkin Chrome-Clad Micrometers now tapped on Warner & Swasey Tapping Machines

THE NAME, LUFKIN, has long been associated with extreme accuracy by users of precision measuring instruments. However, many man-hours of selective assembly were required to assure such accuracy in Lufkin Micrometers—until Warner & Swasey helped simplify and speed up their production.

Now Warner & Swasey No. 11 Precision Tapping and Threading Machines tap the high precision threads necessary in the hub and in the thimble of the micrometer. They perform each of these tapping operations in one pass, where three were previously required. And Warner & Swasey's positive lead screw principle maintains an accurate and constant lead control in these threads. No longer must an operator "feel" his way into the work by hand, or risk damage to the finished threads on withdrawal.

But of particular importance to Lufkin, operators can now qualify the starting positions of the taps so the "zero" mark on the micrometer's thimble matches perfectly with the reading lines on the hub when assembled. This drastically reduces the time-consuming selective and individual fitting of thimble to hub formerly necessary.

Where your work requires extreme threading accuracy on a production scale, call in your nearest Warner & Swasey Field Representative. He'll explain the many unique features of the No. 11 Precision Tapping and Threading Machine, and show you how it can improve your tapping operations.

WARNER & SWASEY *Cleveland*

Warner & Swasey No. 11 Precision Tapping and Threading Machine in use at Lufkin Rule Company, Saginaw, Michigan.

& SWASEY TURRET LATHES, AUTOMATICS AND TAPPING MACHINES

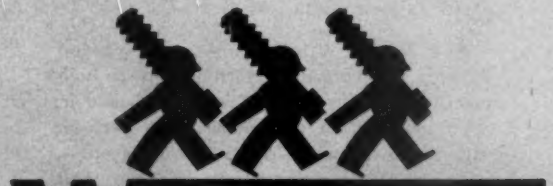
QUALITIES OF CRAFTSMANSHIP IN WINTER CHIP DRIVER TAPS

Precision Chip Driver Contours

Close size control of tapped holes can only be maintained when chip driver contours are held to precision limits. The chip driver contours on Winter Taps are accurate and uniform for free cutting action and high production. Other factors contributing to the superiority of Winter "Balanced Action" Taps are exact flute spacing, uniform flute contours, and accurate and concentric chamfers. The Winter line of threading tools also includes hand, machine screw, pulley, pipe, nut, and tapper taps, and a full complement of dies.

ALWAYS AT YOUR SERVICE

YOUR LOCAL DISTRIBUTOR carries a complete stock of WINTER Taps on his shelves—as close to your tapping problems as the telephone on your desk.



WINTER

WINTER BROTHERS COMPANY • Division of the National Twist Drill and Tool Company, Rochester, Michigan, U. S. A. Distributers in Principal Cities • Branches in New York, Detroit, Chicago, San Francisco

NATIONAL *SHEARING ACTION* HELEX END MILLS

SMOOTH, EFFICIENT OPERATION at high speeds and feeds is yours when you use National "Shearing Action" Helex End Mills. The high helix angle of their cutting edges and their general free cutting action assure better work and long tool life. Helex End Mills are part of National's complete line of rotary metal cutting tools, which also includes twist drills, reamers, milling cutters, counterbores, hobs, and special tools. They are stocked by our distributors near you, and at factory branches in New York, Detroit, Cleveland, and San Francisco.

NATIONAL TWIST DRILL AND TOOL COMPANY,
Rochester, Michigan, U.S.A.

"CALL YOUR DISTRIBUTOR"—

It is NATIONAL'S firm belief, based on long experience, that the local industrial distributor is the one best source for all staple industrial needs—including NATIONAL Metal Cutting Tools.

NATIONAL TWIST DRILL & TOOL — ROCHESTER, MICH., U.S.A.

National

More output per man,

Production Increased 29%

Grade: MX
Size: ¾" Hexagon
Part Name: Master Cylinder Outlet
Machine: 1¼" RA-6 Acme-Gridley
Operations: Forming, drilling, threading, shaving, turning, cut-off

Comparative Production:

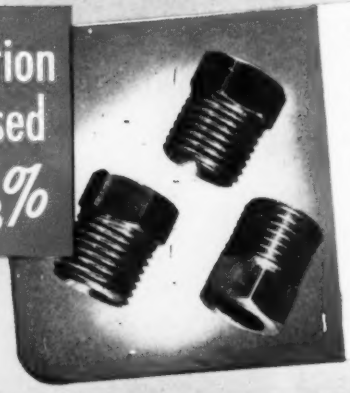
Grade	SFM	Spindle Speed rpm	Seconds Per Part	Hourly Output Rate	Actual Hourly Output*
B-1113	213	942	7¾	465	326
MX	275	1215	6	600	420

Results: Increase in production rate, 29%; increase in surface feet and spindle speed, 29.1%; increase in tool feed, 7.38%. Finish greatly improved.

*Based on 70% efficiency.

Cold-finished material furnished by Canadian Drawn Steel Company, Ltd.

Production Increased 33⅓%



Grade: MX
Size: ½" Hexagon
Part Name: Tube Nut
Machine: ½" Davenport Model "B"
Operations: Forming, drilling, threading, reaming, cut-off

Comparative Production:

Grade	Surface Feet for forming	Surface Feet for drilling	Spindle Speed rpm	Feed for Drill	Seconds Per Part	Hourly Output Rate	Actual Hourly Output*
B-1113	257	139	1700	.0067	2.4	1500	1050
MX	292	157	1930	.0085	1.8	2000	1400

Results: Increase in production rate 33⅓%; increase in surface feet and spindle feed, 13.6%; increase in drill feeds 25.4%, increase in drill surface speed 13.6%. Finish greatly improved.

*Based on 70% efficiency.

Cold-finished material furnished by Canadian Drawn Steel Company, Ltd.

Production Increased 50%

Grade: MX
Size: ⅝" Hexagon
Part Name: Hose End Blank
Machine: 1¼" RA-6 Acme-Gridley
Operations: Forming, drilling, reaming

Comparative Production:

Grade	SFM	Spindle Speed rpm	Seconds Per Part	Hourly Output Rate	Actual Hourly Output*
B-1113	221	1166	6	600	420
MX	290	1536	4	900	630

Results: Increase in production rate, 50%; increase in surface feet and spindle speed, 31.8%; increase in tool feed, 15.9%.

*Based on 70% efficiency.

Cold-finished material furnished by Canadian Drawn Steel Company, Ltd.

per machine, per hour . . . when you do the job with MX

today's freer-cutting screw stock!

UP in Canada, too, manufacturers of screw machine parts know a good thing when they see it. Look over these figures on increased production that one of the biggest parts producers across the border has obtained by switching from ordinary Bessemer screw stock to MX.

Here again, as in shops in this country where U·S·S Free-Machining MX has been put to work, output per man, per machine, per hour has increased. In addition, costs have dropped and part finish has been improved.

While production increases of 29%, 33⅓% and 50% like those shown here are important, equally important is the fact that MX, because of its greater uniformity and better machinability, will permit you to turn out quickly and to close tolerances the more intricate and precise products you are being asked to produce.

What's more, MX will cut the cost of *any* part you now machine from ordinary Bessemer screw stock, even though MX costs a little more. We base this claim on the amazing results obtained with MX to date, in producing over a billion parts of many different kinds.

U·S·S Free-Machining MX more than pays for itself by (1) increasing the rate of production which *lowers the cost per part.* By (2) prolonging tool life which *reduces machine down-time.* By (3) assuring better part finish which often *eliminates extra finishing operations.* By (4) providing closer dimensional accuracy which *minimizes rejections.*

You owe it to yourself—and to your customers—to give MX a trial.

U·S·S Free-Machining MX is being produced in all the popular screw stock sections and sizes. You can obtain it in cold-finished form from your regular supplier as "MX," or under his own identifying trade name. In hot-rolled form, MX is available direct through our nearest district sales office.

Now, when production is more important than ever—speed up the job with MX

IRON AND STEEL
SCRAP is a
VITAL DEFENSE MATERIAL
LET'S GET IT TO THE MILLS
IT MEANS MONEY FOR YOU
MORE STEEL FOR AMERICA

USS

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UNITED STATES STEEL EXPORT COMPANY, NEW YORK

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UNITED STATES STEEL

TRADE MARK

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Presenting

a NEW MARK of Long-Established Quality

Since 1878 and the earliest bicycle cyclometer . . . to the present day when counters are built into everything from hay-balers and textile looms to jet planes and gasoline pumps . . . Veeder-Root has been "the name that counts."

Today, Veeder-Root is the world's largest manufacturer of counting and computing devices for mechanical, electrical, and manual operation. And as a symbol of "the name that counts," this trademark has been developed as a hallmark of old-fashioned quality and modern design *in everything that counts.*

So when you buy counters. look for this mark, and remember: V-R stands for Veeder-Root . . . and also for *"Value Received."*

VEEDER-ROOT INCORPORATED
"The Name That Counts"
HARTFORD 2, CONN. • GREENVILLE, S. C.
Montreal, Canada • Dundee, Scotland
Offices and agents in principal cities

Veeder-Root COUNTERS *"Count Everything on Earth"*

92 hrs. of heat treatment

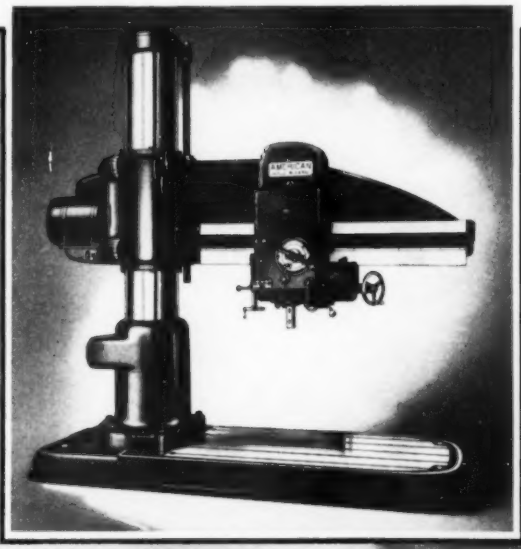
. . . required to produce the ultimate in radial drill spindles

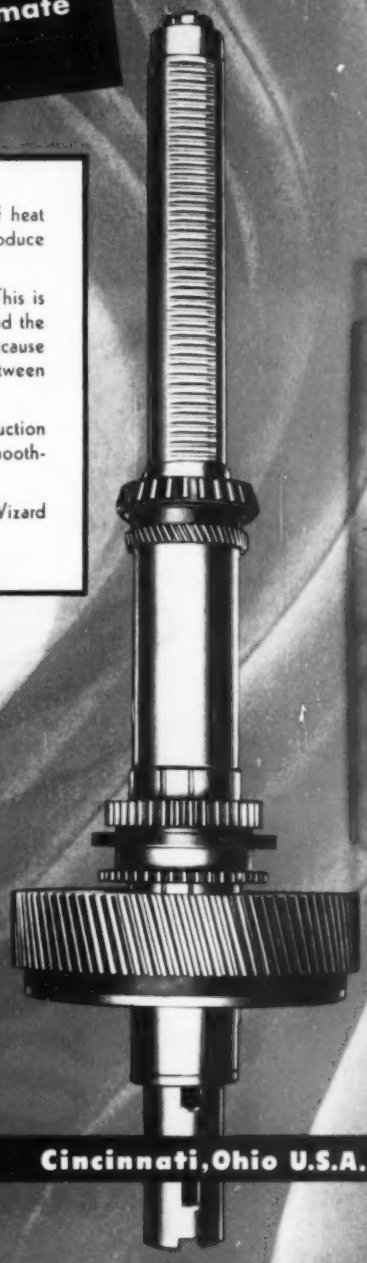
"AMERICAN" Radial Drill Spindles are made of nitralloy. 20 hours of heat treatment from rough to finish, then 72 hours of nitriding are required to produce the wear-resistant spindles used in these radials.

Both the spindles and sleeves are nitrided to 110 degrees scleroscope. This is harder than some grades of cemented carbide. The sleeve is finish honed and the spindle ground and then diamond lapped to a sliding fit in the sleeve. Because of the lack of affinity between these two hard surfaces the clearance between them may be reduced to the very minimum, which in this case is .00025".

This results in the greatest possible stability, resulting in an ideal construction especially for accurate boring operations, which demand a high degree of smoothness and rigidity of the spindle.

This is but one of the super features that make the "AMERICAN" Hole Wizard an outstanding investment.





THE AMERICAN TOOL WORKS CO. **Cincinnati, Ohio U.S.A.**

Lathes and Radial Drills

MORS

END MILLS

are experts at Curling, too!

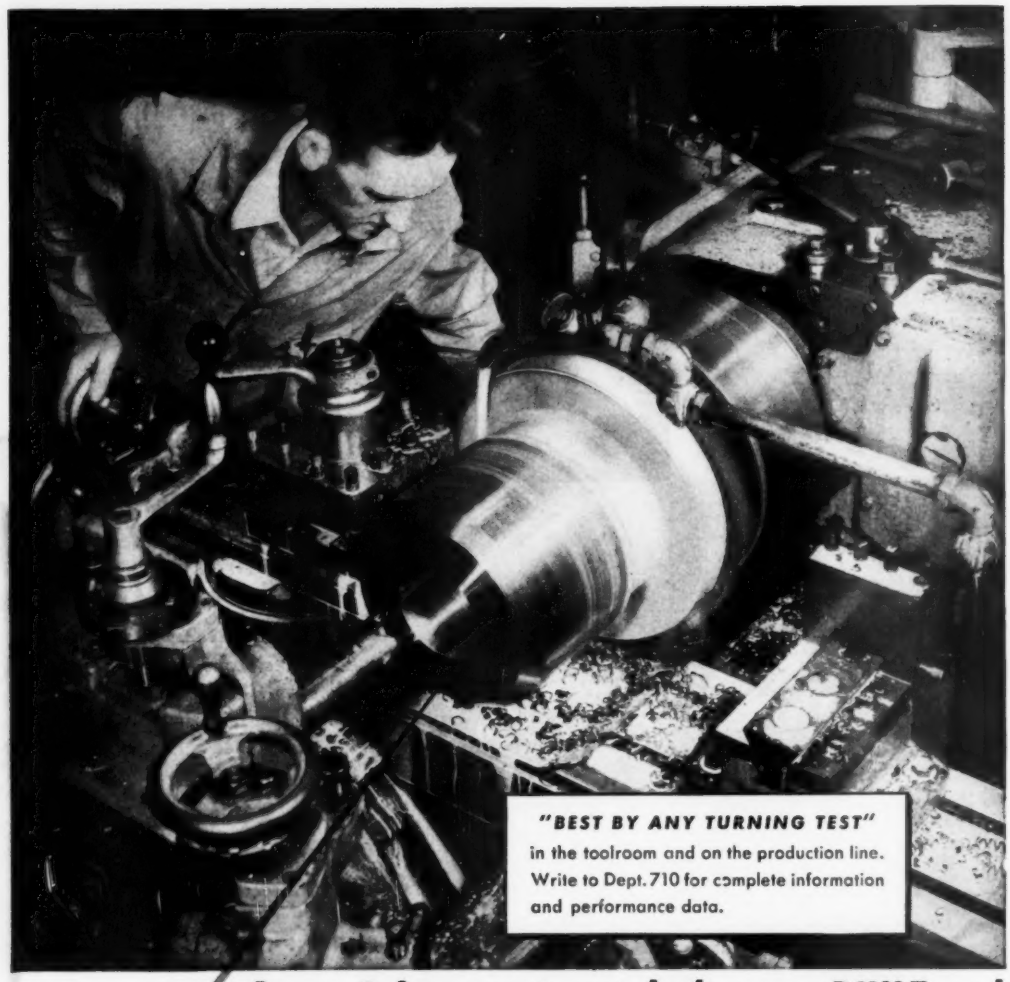
If you want to put the canny Scotch touch on your end-milling costs . . . *then specify Morse Hi-Helix!*

For this is the only design of end-mill that gives you real Morse shear-cutting performance . . . *making the chips CURL and roll out without clogging the flutes.* Cutting action is fast and smooth. Tool-life is far longer. And for even greater tool life, specify Morse Electrolized.

What's more, Morse *Hi-Helix* End Mills are properly undercut and ground with a primary and secondary clearance. And because Morse puts more into their manufacture, you get more out of Morse End Mills in production . . . which makes it just as simple as this: *If you want Morse Quality, then be sure you get genuine Morse Tools.* Ask your Morse-Franchised Distributor . . . he has the stock and the experience to make sure you get exactly what you need.

MORSE TWIST DRILL & MACHINE COMPANY
NEW BEDFORD, MASS.
(Div. of VAN NORMAN CO.)
Warehouses in New York, Chicago, Dallas, Detroit, San Francisco

MORSE
Cutting Tools


"BEST BY ANY TURNING TEST"
in the toolroom and on the production line.
Write to Dept. 710 for complete information
and performance data.

Jones & Lamson turret lathes are BUILT and

POWERED TO PRODUCE

MORE CHIPS **per tool**
MORE PIECES **per hour**
MORE PROFIT **per job . . . than any turret lathe of comparable size!**

Turret Lathe Division **JONES & LAMSON** MACHINE COMPANY
Springfield, Vermont, U.S.A.
MACHINE TOOL CRAFTSMEN SINCE 1835

Photo courtesy Production Machine Co., Greenfield, Mass.

Tapping 8 pieces or 8000?

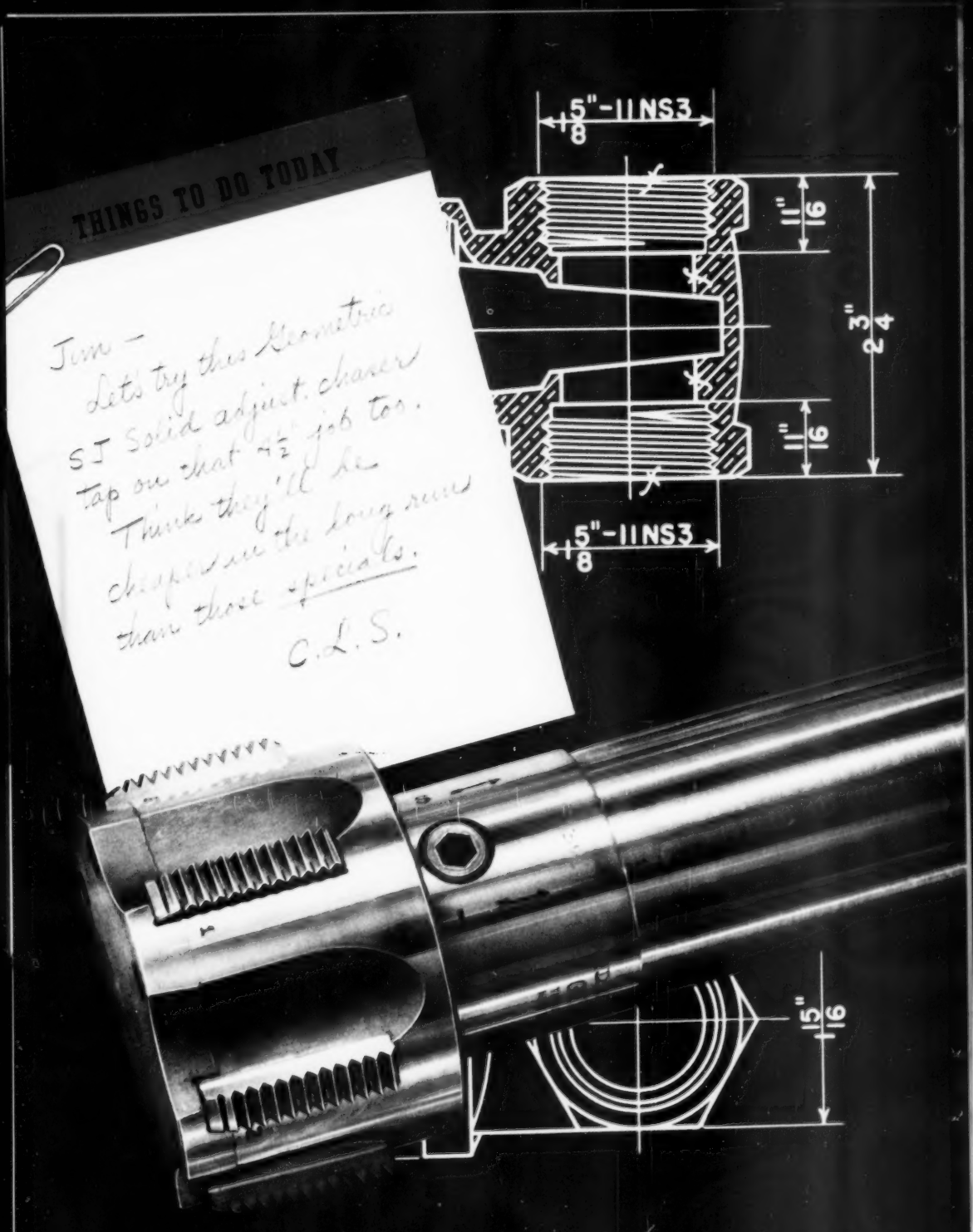
Whether your tapping application is a small-scale job depending on the skill of the operator, or a continuous large-scale operation where down time means troublesome production loss and taps just *have* to be right, you'll like GREENFIELD Taps and GREENFIELD Service.

And, whether you need only a few specially designed taps for a specific job or thousands of identical taps for year-in-year-out operation, you'll also like GREENFIELD Taps and GREENFIELD Service.

At "Greenfield" no tapping job is too small, and no tapping job is too large. For "Greenfield" Taps call your nearest Distributor.

GREENFIELD TAP AND DIE CORPORATION
Greenfield, Massachusetts

BUY GTD GREENFIELD!

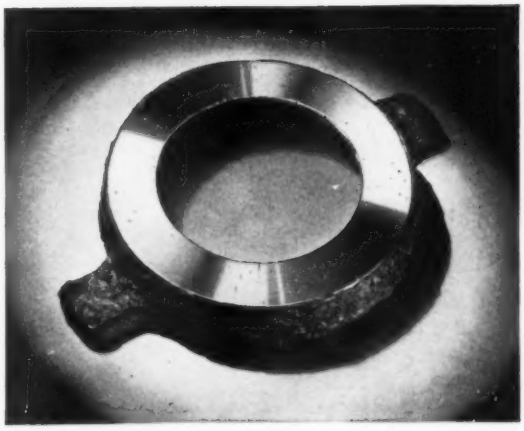


GEOMETRIC TOOL COMPANY DIVISION

Greenfield Tap and Die Corporation

NEW HAVEN 15, CONNECTICUT

NOT WANTED



X-RAY

Good only for scrap. That's the fate of an imperfect casting. No one wants it, but *someone has to pay* once expensive machining has been started.

That's why leaders in industry are placing confidence in radiography. A vital inspection tool for detecting internal discontinuities prior to finishing operations. Before the ledger grows red with costly machining.

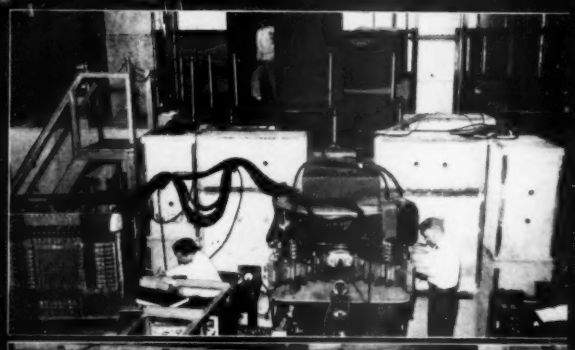
As an inspection device, industrial x-ray is often a non-destructive substitute for physical test and sectioning. But its applications are far broader. In fact, industrial x-ray has become a *development* tool. An instrument that not only diagnoses, but suggests treatment as well. It shows where savings can be made, designs improved.

Write for booklet "Industrial Application of the X-Ray". X-Ray Department, General Electric Company, Room AB-10, Milwaukee 14, Wisconsin.

GENERAL ELECTRIC

300,000,000

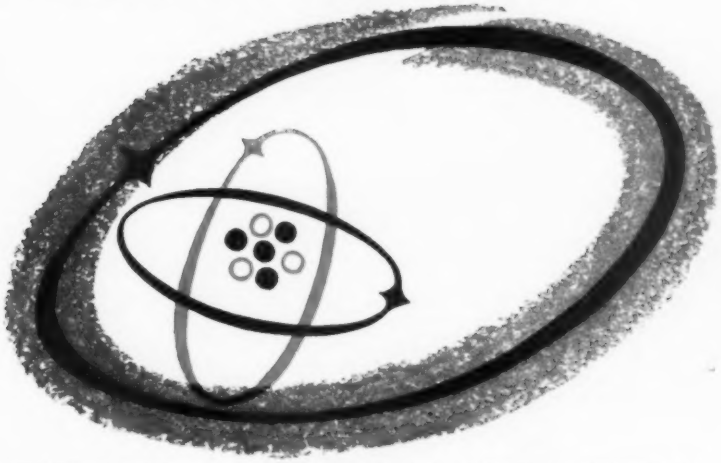
Precision turning of a special part on the LeBlond Dual-Drive Lathe Cornell University Floyd Newman Laboratory of Nuclear Studies.



General view of the Cornell Synchrotron Laboratory.

Master control panel keeps check on synchrotron.

electron volts work here!



Cornell University's synchrotron accelerates atomic particles to energies of 300,000,000 electron volts. It makes possible the study of atomic nuclei and the forces which hold them together.

The Floyd Newman Laboratory of Nuclear Studies at Cornell needed a versatile, precision lathe to turn the myriad of special parts that go into a synchrotron . . . vacuum pump parts and connections, oscillator tube elements, cloud chamber components, plastic lenses, parts for a special stereoscopic camera, and many more.

They installed a new LeBlond Dual-Drive Lathe, recommended by LeBlond Distributor J. F. Owens Machinery Co. of Syracuse, N. Y. Result? Fast, convenient turning of a great variety of special parts to tolerances as low as .0002".

This new LeBlond Lathe provides hardened and ground steel bed ways; twelve speeds from 28 to 1800 r.p.m., all at full power; 96 feeds from .0004" to .1062"; 48 threads from 4 to 224; 15" swing, 3 h. p. motor. It gives you single-lever speed control; positive-jaw feed control; automatic lubrication to headstock, feed box, apron and ways; totally-enclosed quick-change box; and the American Standard taper spindle nose. You get more for your money in a LeBlond Dual-Drive than in any comparable machine.

Likely you'll never build a synchrotron. But for all the turning jobs you do encounter, there's a LeBlond Lathe to turn them faster, better. Your LeBlond Distributor will tell you about the Dual-Drive and other late models. Call him or write—

THE R. K. LEBLOND MACHINE TOOL COMPANY, CINCINNATI 8, OHIO

Ask for Bulletin No. 4A
for more information on the Dual-Drive

turned faster by LEBLOND *of Cincinnati*

WORLD'S LARGEST BUILDER OF A COMPLETE LINE OF LATHES • *FOR MORE THAN 63 YEARS*

This is another of the "HUNDREDS OF JOBS" which can be done on a MARVEL Band Saw!

MARVEL BAND SAW saved these two 4400 lb. castings

Two sand cores washed out when these giant 4400 pound steel connecting rods were cast, resulting in solid eye ends without gaps. Then came the $64 question—how to machine out the 1½" slots in the longitudinal center of the eyes which were 22" high and had a wall thickness of 6½".

The Ernest J. Nelson Iron Works of San Francisco, did this "impossible" job easily, quickly and economically, without special tooling, on a standard Model #8M/2 MARVEL Band Saw. Two cuts were made in each rod in two hours per cut with tool cost of $3.06 per rod. The tool was a MARVEL B9-10 Band Saw Blade.

Every tool room, machine shop and maintenance department needs a MARVEL Series 8 Universal Band Saw—not only for innumerable everyday jobs but for the occasional "trick" operations, where its utmost versatility will save many headaches and dollars.

WRITE FOR CATALOG

MARVEL Metal Cutting SAWS
Better Machines—Better Blades

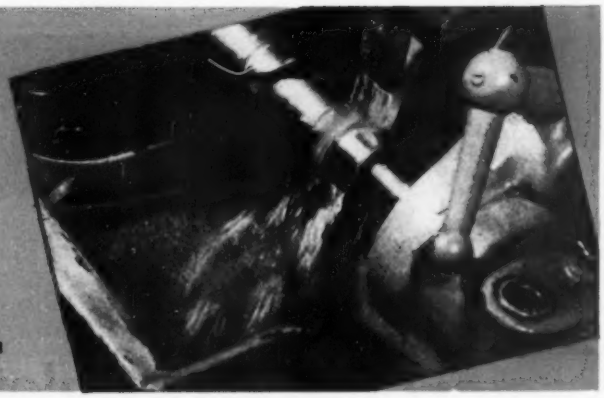
These exclusive MARVEL Features made this job easy.

1. Large, T-slotted work table.
2. Blade feeds into work vertically; work always stationary.
3. Power-pressure feed.
4. Automatic Blade tension.
5. Built-in coolant system.
6. Large capacity.

ARMSTRONG-BLUM MFG. CO.

5700 BLOOMINGDALE AVENUE **CHICAGO 39, ILLINOIS**

RESULTS...
never before realized with coolants... can be YOURS... with revolutionary
POWDER'D OIL



POWDER'D OIL for grinding used on precision external grinding of Carpenter Tool Steel in a Brown & Sharpe Cylindrical Grinder.

Photo . . . Courtesy of FEDERAL MACHINE & TOOL CO., Long Island City, N. Y.

Easily proved advantages mean BIG SAVINGS and BETTER WORK

Verdicts of those who have tried POWDER'D OIL add up to just this: here is a coolant that is definitely superior to old fashioned methods and which produces far better work at lower coolant costs.

Used for grinding, this free-flowing, specially compounded golden powder, when mixed with water, produces a clear light green solution which, in replacing soluble oils and chemicals:

. . . operates cooler because of its refrigerating properties (a feature which now, for the first time), can be definitely proved.

. . . assures cleaner grinding, longer wheel life and better finishes.

. . . enables operators to see their work because solution is clearly transparent.

. . . is easily handled and mixed, with no oil spillage, waste or danger of slippery floors.

. . . remains stable in solution and does not separate, assuring longer solution life and better rust protection.

. . . has a mild sweet odor and is free from rancidity, greasiness and gumminess; is *safer* and cleaner for men and machines.

In addition, POWDER'D OIL is shipped in fibre containers, rather than steel drums, saving shipping charges and eliminating return shipping costs of drums, as well as costly drum deposits.

POWDER'D OIL is also available for *cutting* with advantages already noted, plus increased tool life and production.

These facts suggest giving POWDER'D OIL an immediate trial. Prove for yourself on your own work the revolutionary features of this up-to-the-minute coolant by sending TODAY for a 50-lb. drum.

Read What Users Say

● "POWDER'D OIL is easier to handle than ordinary soluble oil, and the clear solution enables operators to see their work at all times."
(A large Automotive Accessory manufacturer)

● "POWDER'D OIL keeps grinding wheels clean and free cutting, and the solution remains sweet."
(A large Steel company)

● "POWDER'D OIL foams less and produces excellent finishes."
(A large Firearms manufacturer)

● "We were pleasantly surprised with the excellent all around results obtained with POWDER'D OIL for grinding."
(A large Saw manufacturer)

The Sanson Line of POWDER'D OILS for:

Grinding (General Purpose)	Stamping Non Ferrous Metals
Grinding Cast Iron	Dip Drawing
Grinding Aluminum	Wire Drawing
Cutting (General Purpose)	Rolling
Cutting Cast Iron	Honing
Cutting Aluminum	Burnishing
Stamping Steel	Rust Protection
	Fast Quenching

MAIL COUPON TODAY for TRIAL ORDER

HENRY E. SANSON & SONS, INC., 145 Quaker Ridge Road, Manhasset, Long Island, N. Y.
Oils and Chemicals for Industry
Plants: Long Island City, N. Y.—Newark, N. J.—Philadelphia, Penna.

Gentlemen: Kindly send a 50# drum of POWDER'D OIL for .....
It is understood that I will be credited with the amount invoiced if I am not entirely satisfied with the results of my trial, and on receipt of return of the unused portion of the shipment.

Name .....

Position .....

Company .....

Address .....

(Please insert type of POWDER'D OIL desired)

ADAMAS

...now has a complete range of solid carbide inserts in stock for you!

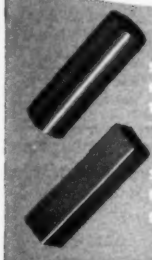
ADAMAS rounds out its line and brings you GOOD NEWS ON FAST DELIVERY for all of your finish ground solid carbide insert blanks and centerless ground solid cylinders, in a complete range of styles and sizes. Your orders will be shipped IMMEDIATELY from our large and adequate stocks, they're available in all of the standard grades for these styles of blanks.

Our new Stokes S-5—a high production press of the largest type in use in the carbide industry—ASSURES YOU of the USUAL PROMPT ADAMAS SERVICE on SC, TB, SQ, and RB style blanks.

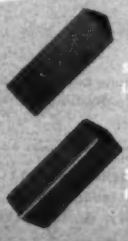
Smart carbide users always

Specify **ADAMAS TUNGSTEN CARBIDE**

for the triple advantages of quality, delivery and price



Style SC Solid Round Inserts for Boring Tools, Insert Type Tools, and wear parts



Style TB Triangulars for Insert Type Tools

Style RB Rectangular for Insert Type Tools all finish ground.

Style SQ Squares for Insert Type Tools

Send today for the NEW ADAMAS CATALOG #A851 the latest "AID to CARBIDE USERS"

ADAMAS CARBIDE CORPORATION

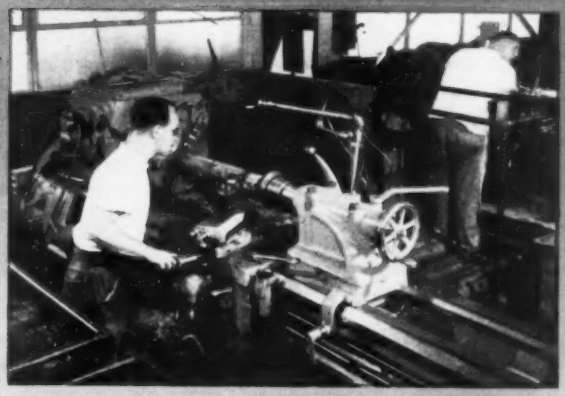
1000 SOUTH 4th ST., HARRISON, N. J.

PRODUCERS OF TUNGSTEN CARBIDE TOOL TIPS, DIES AND WEAR PARTS

SPRINGFIELD LATHES

on the PAYLOADER

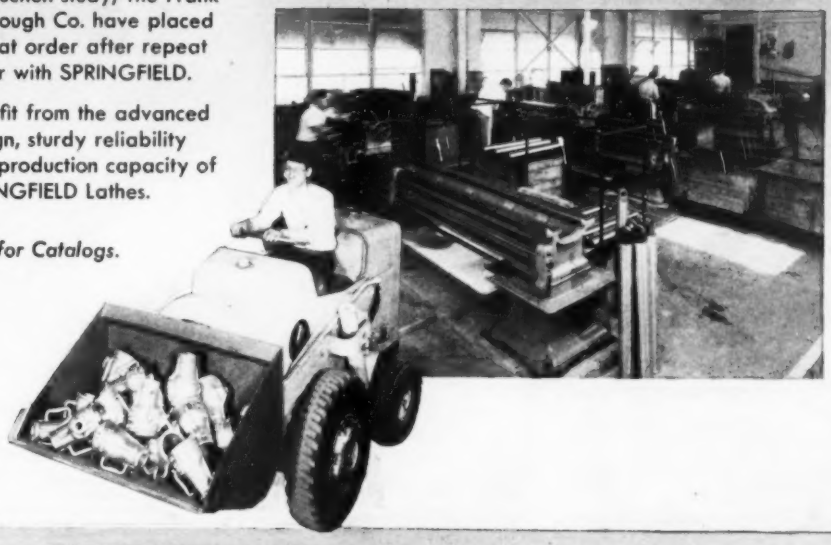
Years of experience in applying engine lathes to the production of various parts for the world-famous **PAYLOADER** have convinced The Frank G. Hough Co., Libertyville, Ill., SPRINGFIELD LATHES are completely satisfactory, extremely versatile and productive.



On the basis of actual records of their installations, operator preference, maintenance cost and production study, The Frank G. Hough Co. have placed repeat order after repeat order with SPRINGFIELD.

Benefit from the advanced design, sturdy reliability and production capacity of SPRINGFIELD Lathes.

Ask for Catalogs.



THE SPRINGFIELD MACHINE TOOL COMPANY

SPRINGFIELD, OHIO, U. S. A.

GENERAL DISTRIBUTORS: BRYANT MACHINERY & ENGINEERING COMPANY, 400 WEST MADISON ST., CHICAGO 6

Exclusive Representatives in All Principal Cities

"SKIL Drills and Drivers

GIVE US THE FASTEST PRODUCTION WITH THE LOWEST MAINTENANCE COSTS,"

says Mr. N. Y. Starke, *President*, NAMOR PRODUCTS, Inc., *Cleveland, Ohio*
Manufacturers of the Namor dinette line.

SKIL Drills and SKIL Drivers prove their efficiency and economy all along the production line of Namor Products, Incorporated, manufacturers of widely-known dinette furniture. The drills are used singly or in multiples of three or four to bore more than 600 holes every day through the Formica tops and wooden bases of the table leaves. The drivers attach hardware to the underside of the tables and complete the assembly of the tubular chairs.

SKIL Tools have been on this job with top performance for more than two and a half years, working continuously hour after hour, day after day. These hard-working tools have required little maintenance and the cost of that maintenance has been remarkably low. That's why Mr. Starke says, "We enthusiastically endorse SKIL Tools."

3 AT A TIME . . . 4 AT A TIME

SKIL Drills in SKIL Bench Stands bore clean and accurate holes through wood and Formica for insertion of dowel pins in the table leaves. Namor Products, Inc., uses seven Model 241 SKIL Drills, endorses the smooth-running, reliable service they give.

SKIL DRILL—MODEL 241
One of 26 SKIL Models

¼" special duty drill. Capacity: 0" to ¼" in steel, 0" to ½" in hardwood. Speed: 2250 r.p.m. no-load. Overall length: 11¼". Weight: 4¾ pounds.

SKIL Bench Stands quickly convert any SKIL Drill into a stationary drill press.

"EASY TO USE... EASY TO HANDLE"

SKIL Drivers—12 of them—speed assembly. These drivers are compact for easy one-hand operation, so light in weight that handling doesn't tire the operator. The adjustable clutch is quickly set to uniform, pre-determined tension and eliminates excessive shock of sudden stops.

SKIL DRIVER—MODEL 303
One of 20 SKIL Models

Capacity: ¼" diameter machine screws, nuts; No. 12 self-tapping screws. Speed: 750 r.p.m. no-load, standard: speed of 1000 and 1250 r.p.m. at no extra cost. Overall length: 11¼". Weight: 3¾ pounds.

MODEL 489—Similar to Model 303 but with reversing switch.

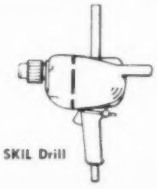
See your SKIL Distributor for demonstrations and complete information

SKIL Products are made only by SKILSAW, Inc.
5033 Elston Avenue, Chicago 30, Ill.

SKILSAW Factory Branches in Principal Cities
In Canada: Skiltools, Ltd., 3601 Dundas Street West, Toronto 9, Ont.

SKIL
PORTABLE TOOLS

SKIL Saw



SKIL Drill

SKIL Belt Sander

SKIL Grinder

SKIL Driver

Sing a Song of

Surface Plates

General Manager

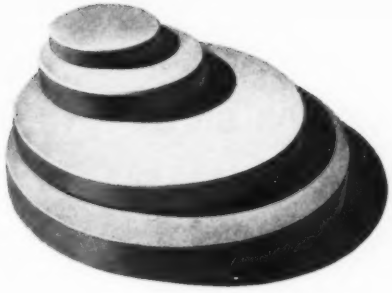
Chief Inspector

Purchasing Agent Superintendent

they all sing praises of

NORTON

Surface Plates



If you haven't yet heard a song about surface plates, it may be because you haven't adopted Norton Ceramic Surface Plates in your plant.

We cannot guarantee that you will develop a quartet to join the Society for the Preservation of Barbershop Singing in America, but you can be sure of finding four who will sing the praises of Norton Ceramic Surface Plates.

Your General Manager—and other top management men—will find these hardest of all surface plates in tune with today's needs for maximum production with optimum accuracy. Made of one of the hardest substances known, these ceramic surface plates show off to best advantage on your severest production gaging and blueing operations.

Your P. A. will be humming with satisfaction over the way these ceramic surface plates pay off in extra-long, trouble-free service. In both laboratory and field tests Norton surface plate life has been shown to be at least 40 times that of the best competing type.

Your Superintendent will like the harmony in his department that comes from men working with the easy-to-use Norton Ceramic Surface Plates. These plates will never sweat nor corrode under any conditions. Greasing is unnecessary and the plates require no protection from moisture. Made of a durable and stable material, Norton surface plates will not warp nor deform; will never give expansion troubles; will not deflect under load.

Your Chief Inspector will really sing for joy over the aid to precision checking operations given by these ceramic surface plates. Offering a new precision standard of continuously smooth surface finish, Norton surface plates allow easy movement of instruments and work across the plate without excessive drag and without vibration. The precision flatness of these ceramic surface plates not only is important to precision measuring operations but also helps prevent wear of expensive instrument bases, gage blocks, and sine bars.

NORTON

NORTON COMPANY, WORCESTER 6, MASS.
DISTRIBUTORS IN ALL PRINCIPAL CITIES

You can do 'most any job on a

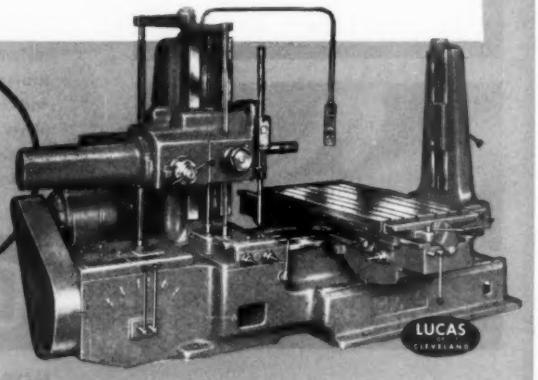
LUCAS

And . . . because you can do such a wide variety of operations on a Horizontal Boring Machine, it is today one of the most CRITICALLY NEEDED machine tools in the entire re-armament program.

The overwhelming demand for the LUCAS Horizontal Boring Machine, which embodies every important design improvement, many exclusive with Lucas, has built up a backlog of priority orders which make short time deliveries difficult.

Therefore . . . in appreciation of your preference for Lucas Machines, we gladly offer our services and suggestions on how better methods and improved operating practices can help you to step-up production on your present Boring Machine equipment until your new LUCAS can be delivered.

Automatic Power Positioning ★ Integrally cast 4-way beds with 4-point support ★ Complete range of feeds and speeds to one spindle ★ Pendant Control ★ Vibrationless V-belt drive to spindle at high speeds ★ Complete line of attachments ★ Chrome plated lead screws



LUCAS

Precision HORIZONTAL BORING DRILLING AND MILLING MACHINES

LUCAS MACHINE DIVISION, THE NEW BRITAIN MACHINE CO., CLEVELAND 8, OHIO

which of these feed-in duct features rate highest with you?

architects

rate these SQUARE D features particularly high:

lowest known voltage drop . . . maximum efficiency, minimum power loss

smallest cross-sectional area . . . conserves valuable installation space

contractors

give these features top billing:

reduced installation time . . . simplified components, factory prefabrication

new joint design *(lower right)* . . . all joint ends identical, connection bolts face outward

interchangeable standard fittings . . . permit horizontal or vertical riser applications

users

vote these SQUARE D features tops:

low cost installation and maintenance . . . most accessible connections

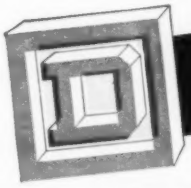
totally enclosed . . . permanent safety construction, excludes dust

completely reuseable . . . rearrangement with the same components

EXCLUSIVE JOINT DESIGN

SQUARE D's **exclusive** joint design saves installation time and reduces maintenance cost. Joint ends are identical—unnecessary to select mating ends before positioning or hanging duct sections. Outward-facing, pre-installed bolts permit rapid assembly and easy maintenance.

ASK YOUR ELECTRICAL DISTRIBUTOR FOR SQUARE D PRODUCTS



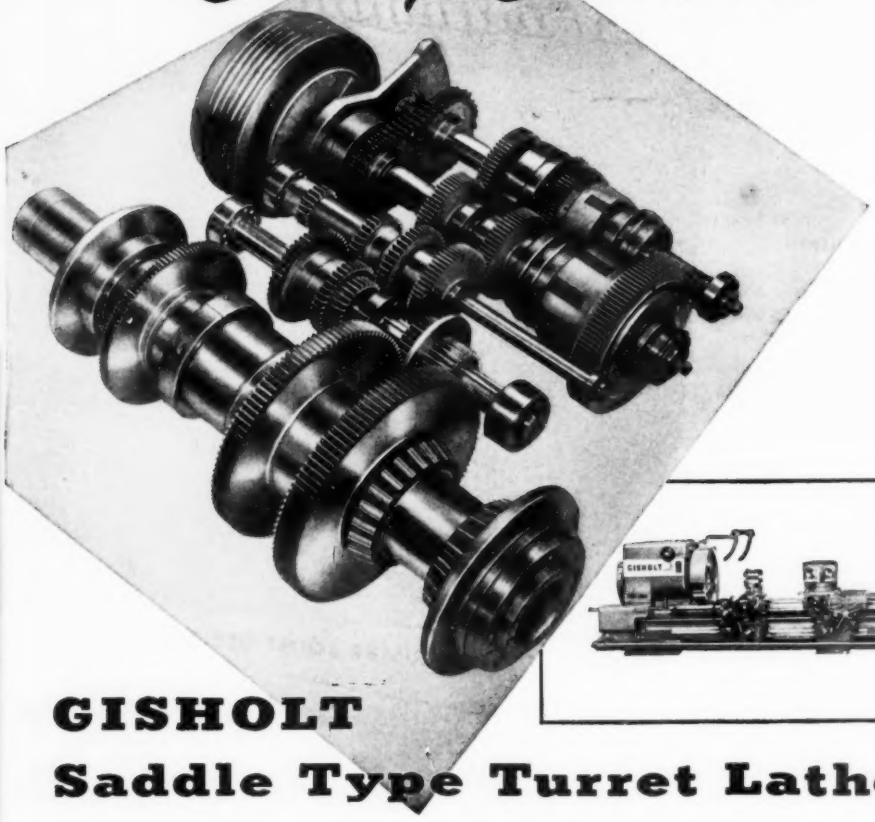
SQUARE D COMPANY

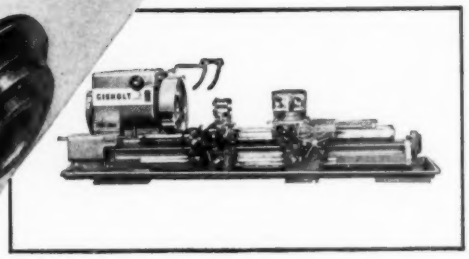
DETROIT · MILWAUKEE · LOS ANGELES

SQUARE D COMPANY CANADA LTD., TORONTO • SQUARE D de MEXICO, S.A., MEXICO CITY, D.F.

RUGGED POWER

Silky Smooth





GISHOLT
Saddle Type Turret Lathes

Here's how modern Gisholts are geared for greater production—to deliver smooth, vibrationless power—instantly responsive—dependable for years to come. Note these outstanding features:

1 *Gears* . . . Husky headstock gearing will carry all the horsepower and all the load of today's tools, as well as that of the foreseeable future. Rigidity is complete from the massive headstock casting right through to the ground teeth in each gear.

2 *Clutches* . . . Warner Electric Clutches inside the drive pulley do all forward and reverse driving, as well as inching and braking. They never need adjustment and give the smoothest acceleration and braking power ever put on a turret lathe. Instant HI-LO speed changes are obtained at the touch of a finger through hydraulically operated multiple disc clutches.

3 *Bearings* . . . Two precision tapered roller bearings at the front of the spindle, together with the precision ball bearing at the rear, carry all the radial and thrust load you can give them.

Why not get all the facts? A new bulletin on Gisholt 3L, 4L, 5L Saddle Type Turret Lathes is just off the press. Write for it.

GISHOLT MACHINE COMPANY
Madison 10, Wisconsin

THE GISHOLT ROUND TABLE

represents the collective experience of specialists in the machining, surface-finishing and balancing of round and partly round parts. Your problems are welcomed here.

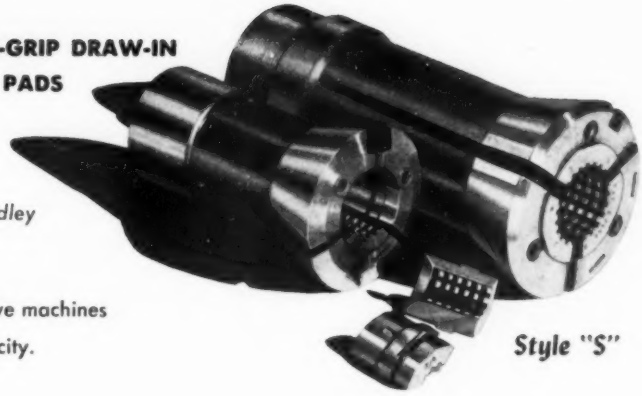
TURRET LATHES • AUTOMATIC LATHES • SUPERFINISHERS • BALANCERS • SPECIAL MACHINES

HARDINGE ELMIRA N.Y.

STYLE "S" SURE-GRIP DRAW-IN MASTER COLLETS and PADS

Cleveland
Cone
Greenlee
Gridley and Acme-Gridley
National Acme
New Britain

Available for all sizes of above machines up to and including 3½" capacity.



Style "S"

HARDINGE ELMIRA, N.Y. *Masters and Pads* *for* BETTER PERFORMANCE *and* BETTER PRODUCTION

HARDINGE ELMIRA N.Y.

STYLE "B"

MASTER FEED FINGERS and PADS

Brown & Sharpe
Cleveland
Cone
Davenport
Greenlee
Gridley and Acme-Gridley
National Acme
New Britain

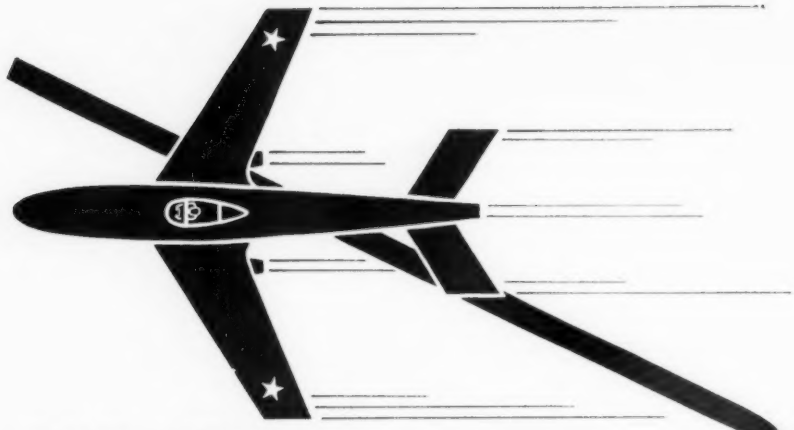
Available for all sizes of above machines up to and including 3½" capacity.

Style "B"

Ask for Style "S" and Style "B" Bulletins which give all performance features, price savings, and ordering information.

HARDINGE BROTHERS, INC., ELMIRA, N. Y.

"PERFORMANCE HAS ESTABLISHED LEADERSHIP FOR HARDINGE"



TUF-STUF'S best proving ground is in the air!

It pays to specify *TUF-STUF* aluminum bronze alloys for parts that must stand up

● Because they are both light and tough, TUF-STUF aluminum bronze alloys have proven invaluable in America's aircraft as valve-seat inserts, spark plug inserts, valve guides, gears and other vital parts.

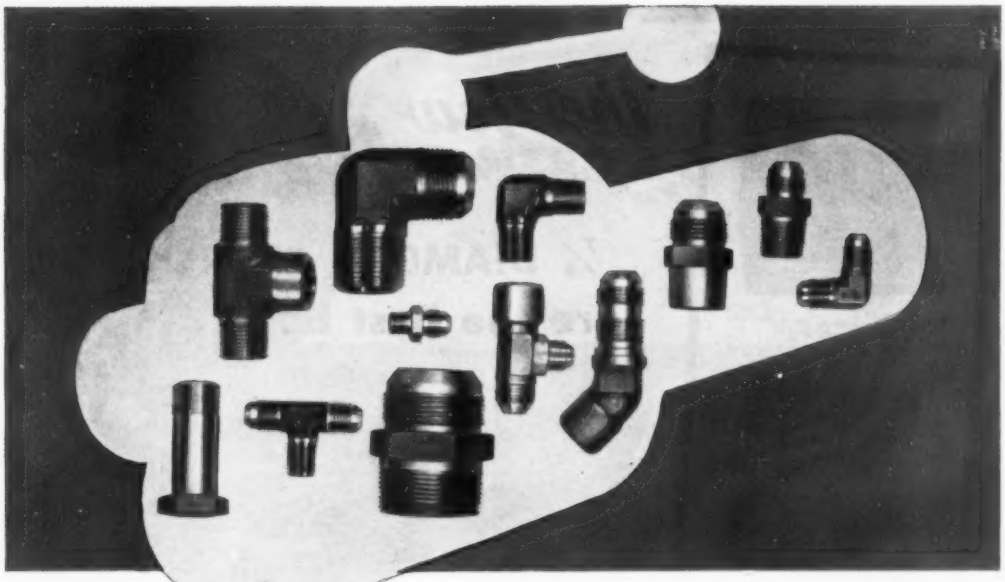
If your product requires machined parts that are strong but light, resistant to corrosion, long wearing and resistant to oxidation even at high temperatures, then TUF-STUF is the right alloy for the job.

TUF-STUF alloys are furnished in the form of forgings, rods and screw machine parts. They fill Federal Specification QQ-B-666, Grade B, and several other variations. Because of the increased use and demand for both aluminum and copper, jobs carrying a Defense Order Number are receiving first consideration.

MUELLER BRASS CO.

PORT HURON 18, MICHIGAN

61



VERS-O-TOOL—THE STANDARD

at The Parker Appliance Co.— FOR THIS CLASS OF WORK

VERS-O-TOOL FEATURES

1. Circular chasers are always up to correct position — assuring precision threads and smooth finish.
2. Accuracy of thread form is assured throughout the life of a circular chaser, by means of direct micrometer check after each regrind.
3. Vers-O-Tool circular chasers are regrindable through a full 270°—an exclusive feature, for longer life.
4. Circular ground thread chasers are available in a full range of thread sizes—even down to 260 TPI.

You can't afford to take chances on aircraft tube fittings. That's why a Class 3 Fit is required on all straight threads for Parker AN Fittings. Similarly, all taper threads must be basic-checked with ring, profile and tri-roll gauges—*and all threads must have extra-smooth finishes.*

And that's why you'll find Vers-O-Tools used as the standard for production at Parker. They've found, through carefully-checked records, that no other die-heads can deliver the same exacting high quality on long, tight-schedule production runs.

There are other reasons, too: lower chaser costs, less tool inventory, faster machining time—all these tip the scales to Vers-O-Tools. For complete details on how they can improve quality and cut costs in your shop, ask for catalog D-49.

The NATIONAL ACME CO.

170 EAST 131st STREET • CLEVELAND 8, OHIO

Acme-Gridley Bar and Chucking Automatics: 1-4-6 and 8 Spindle • Hydraulic Thread Rolling Machines • Automatic Threading Dies and Taps • The Chronolog-Limit, Motor Starter and Control Station Switches • Solenoids Centrifuges • Contract Manufacturing

Shop Set MTT . . . . 35 blocks giving 140,000 combinations in ten thousandths. Price in mahogany case, $115.00.

Economy Set MT . . . . Over 5000 combinations in thousandths. Price in mahogany case, $46.00.

Micrometer Set M21 . . . . Includes 1", 2", 3", 4", 5", and 6" Microgages. Price in mahogany case, $69.00.

Toolmakers Set M64 . . . . Gives 121 combinations in 10ths, 32nds and 64ths. Price in mahogany case, $20.00.

The New Van Keuren

7/8 DIAMETER MICROGAGES are the best buy . . . . . .

60% More Wearing Surface . . . 25% Greater Accuracy . . . No increase in price.

A FOUNDATION FOR ACCURACY FOR 25 YEARS

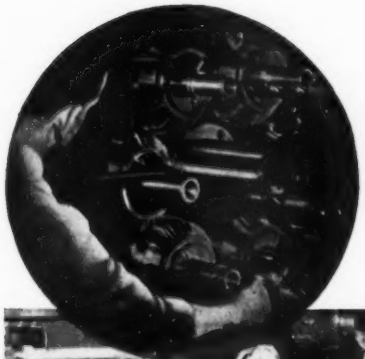
Van Keuren Microgages have been popular for over 25 years, because they provide a low cost means of securing accuracy in the shop, to meet the demands of the inspection department. The original Microgages were made 11/16" in diameter. The 7/8" body diameter of the NEW Microgages are ground true cylinders, and the end surfaces are held square with the body within close limits. This enables them to be easily aligned on machine ways for measuring carriage travel. The new Microgages have 40% more wearing surface than rectangular gages and they wring together tenaciously. The 7/8" diameter body provides excellent rigidity for the 6" long blocks.

Microgages up to 1" length are held within a tolerance of plus 12 millionths minus 8 millionths. They have an average wear allowance of 4 millionths oversize. They are available as individual gages from .0625" to 6" length, or in sets especially designed for general shop use, for tool setting and for tool makers and machinists.

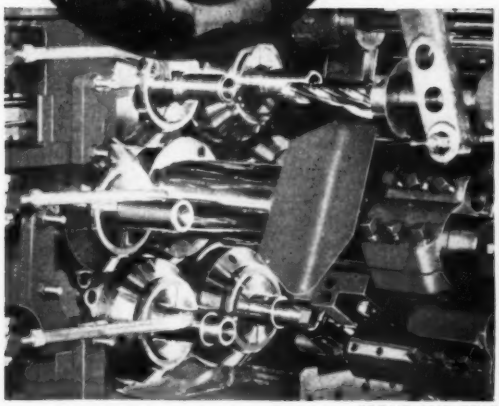
THE Van Keuren CO., 173 WALTHAM STREET, WATERTOWN, MASS.

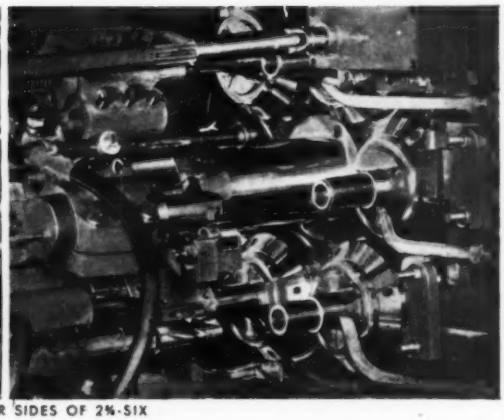
32nd YEAR

Light Wave Equipment • Light Wave Micrometers • Gage Blocks • Taper Insert Plug Gages • Wire Type Plug Gages • Measuring Wires • Thread Measuring Wires • Gear Measuring System • Shop Triangles • Carboloy Plug Gages • Carboloy Measuring Wires



NO NEED TO "SETTLE" FOR LESS





FRONT AND REAR SIDES OF 2¼-SIX

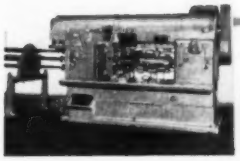
Multiple Spindle Bar Automatics produce more work per square foot of floor space than do other types of metal cutting machine tools. But, when *one* spindle is "down" *all* are "down." It's why dependability will always be the outstanding requirement of the "Automatic."

So many factors are involved in dependability that any weakness in design, engineering, material, or construction, will eventually contribute to higher costs of operation and maintenance.

Part of any new machine's service to the prospective user is the availability of *full* information. No prospective purchaser need "settle" for less. At least it's that way with CONOMATICS.

In producing the piece shown, on a 2½-SIX, the eccentric forming attachment (see upper right illustration) combines the well known CONOMATIC facilities of form tool support and "all position" attachment spindle drive.

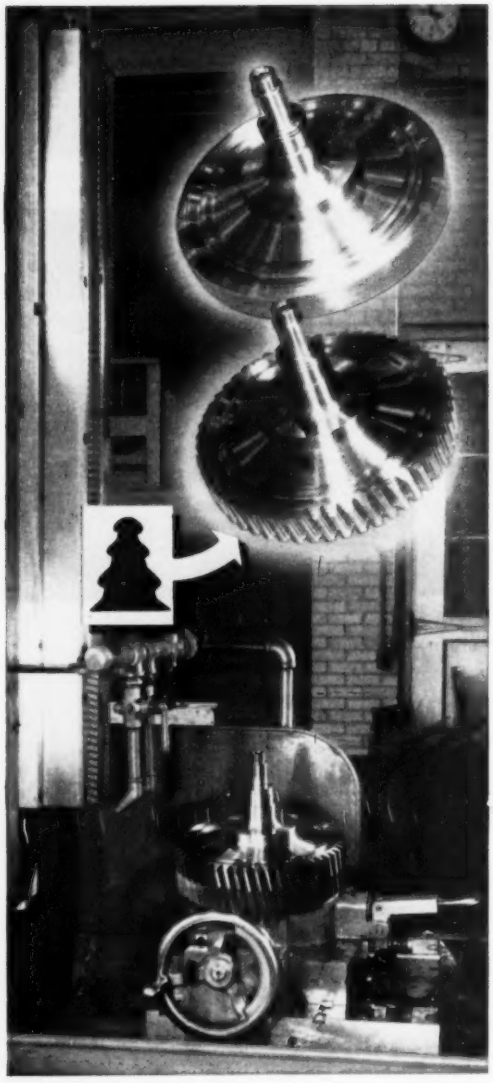
A Comparison of ALL Automatics is in favor of Cone



Conomatic

CONE AUTOMATIC MACHINE COMPANY, INC.
WINDSOR, VT., U.S.A.

Broaching the Xmas Tree Shape in Turbine Wheels



THE ENGINEERED *American* WAY

Broaching an intricate Xmas Tree Shape to close tolerances is another problem solved efficiently and economically by American Engineers.

With a tough steel to machine (316 Stainless) and close tolerances to maintain, it was necessary to first rough and then finish broach the Xmas Tree Shape.

The rough and finish broaching operations were combined on a single ram American SB-54-10. This was accomplished by mounting rough and finish broach inserts on the machine slide and designing the fixture to traverse laterally from the rough position to the finishing position. The fixture was mounted on a hydraulically operated receding work table.

The operation sequence is as follows:

1. The part is secured on a manually indexed fixture.
2. The angular slots are rough broached around the entire periphery of the wheel at the first station.
3. The complete fixture is then traversed laterally to second station for broaching Xmas Tree form.

Fifty-three (53) Xmas Tree Shapes are broached ½" deep through 1⅝" length of cut on a 11¾" diameter wheel.

American Engineering is available for all turbine Broaching problems.

Engineered Broaching by American has proven time and again the way to economy and high production on a multitude of metal cutting operations. An engineered combination of American Broaching Machines, fixtures, and broaches is the efficient answer to production questions. Why not ask your question? Send a sample part, or blueprint, plus hourly requirements. We'll be glad to make recommendations. Request your copy of Circular Number 300. Address Department A

AMERICAN *American* BROACH & MACHINE CO.

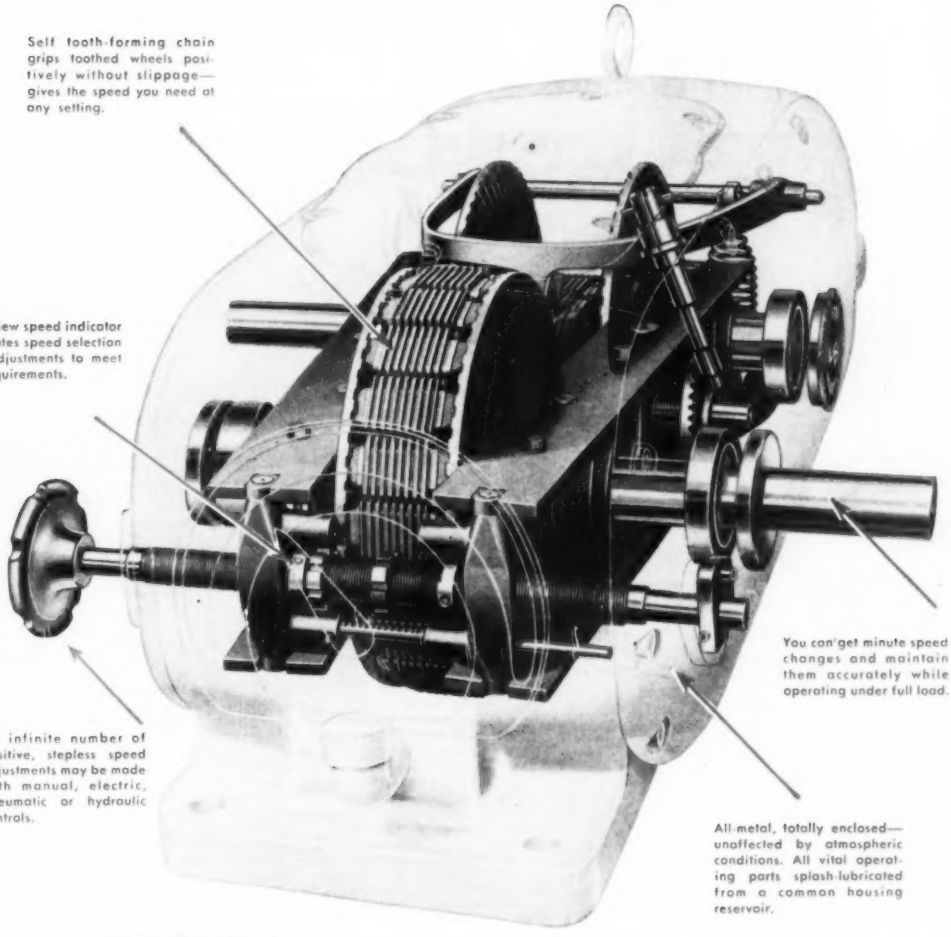
A DIVISION OF SUNDSTRAND MACHINE TOOL CO.

ANN ARBOR, MICHIGAN

SUNDSTRAND

See *American* First — for the Best in Broaching Tools, Broaching Machines, Special Machinery

Only the P.I.V. gives you all these advantages in a variable speed drive

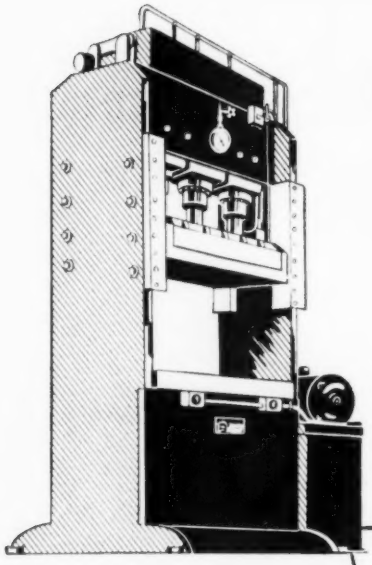

Self tooth-forming chain grips toothed wheels positively without slippage—gives the speed you need at any setting.
Easy-view speed indicator facilitates speed selection and adjustments to meet all requirements.
You can get minute speed changes and maintain them accurately while operating under full load.
An infinite number of positive, stepless speed adjustments may be made with manual, electric, pneumatic or hydraulic controls.
All-metal, totally enclosed—unaffected by atmospheric conditions. All vital operating parts splash-lubricated from a common housing reservoir.

ALL INDUSTRY USES P.I.V.

Capitalize on the advantages of the P.I.V.—the variable speed drive that is not dependent on friction for the transmission of power. This compact, all-metal precision unit provides the most accurate infinitely variable means for using machines to maximum capacity for the job at hand. It can be operated manually or automatically while running under full load. The Link-Belt district office nearest you is equipped to supply complete, detailed information on variable speed transmission.

LINK-BELT COMPANY: Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices, Factory Branch Stores and Distributors in Principal Cities. 12,220

P.I.V. LINK-BELT VARIABLE SPEED DRIVE



K·R·WILSON IS IN THEIR CUPS!

Lily Cups

FAMOUS NAME IN PAPER CUPS CUTS COSTS WITH KRW HYDRAULIC PRESS!

Here's another in the KRW parade of contented customers! Lily Tulip Cup Corp. of New York City is saving money *three ways* with KRW. First, the initial cost of a K. R. Wilson Hydraulic press is much less than heavier, mechanical equipment designed for the same job. Second, no expensive foundations are needed because KRW Hydraulic presses are all self-contained above ground. And third, KRW presses do much of the work of heavier, more expensive equipment at far less cost.

How about you? Need hydraulic presses in your operations? If so, you'll find that the fast, flexible, rugged KRW presses can save you money on scores of production or maintenance jobs. Available in 25-150 ton capacities, one, two and three cylinder models . . . either hand operated, air operated or motor driven. And if you need a special press to do a special job, let us know! We'll build one to your specifications. Delivery? Fastest you can get anywhere!

K·R·WILSON

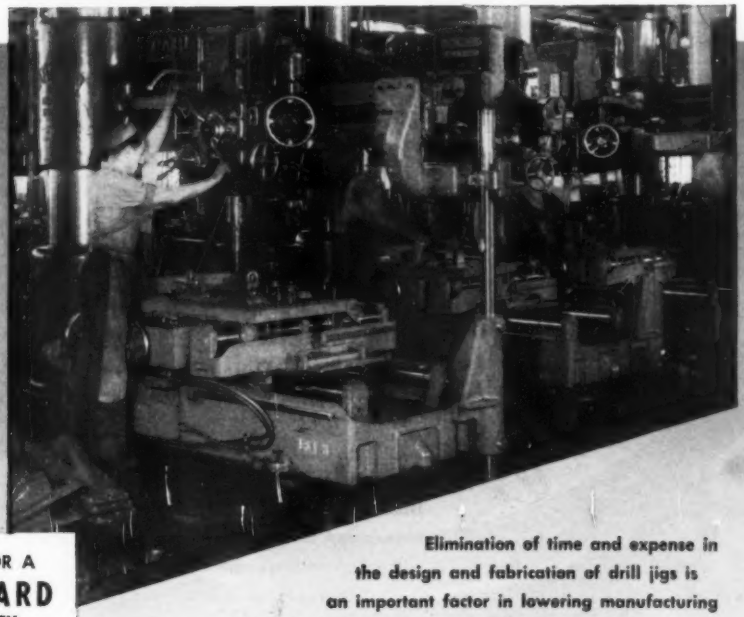
Ask Your Machinery Dealer to Quote Prices or Write or Wire Dept. 11

215 MAIN STREET • BUFFALO 3, N. Y.

THE PRICE OF BULLARD SPACERS

FROM THE COST OF JIGS

From 40 to better than 50% Operational Savings shown in Case Histories



ASK FOR A **BULLARD** SURVEY OF YOUR JOBS

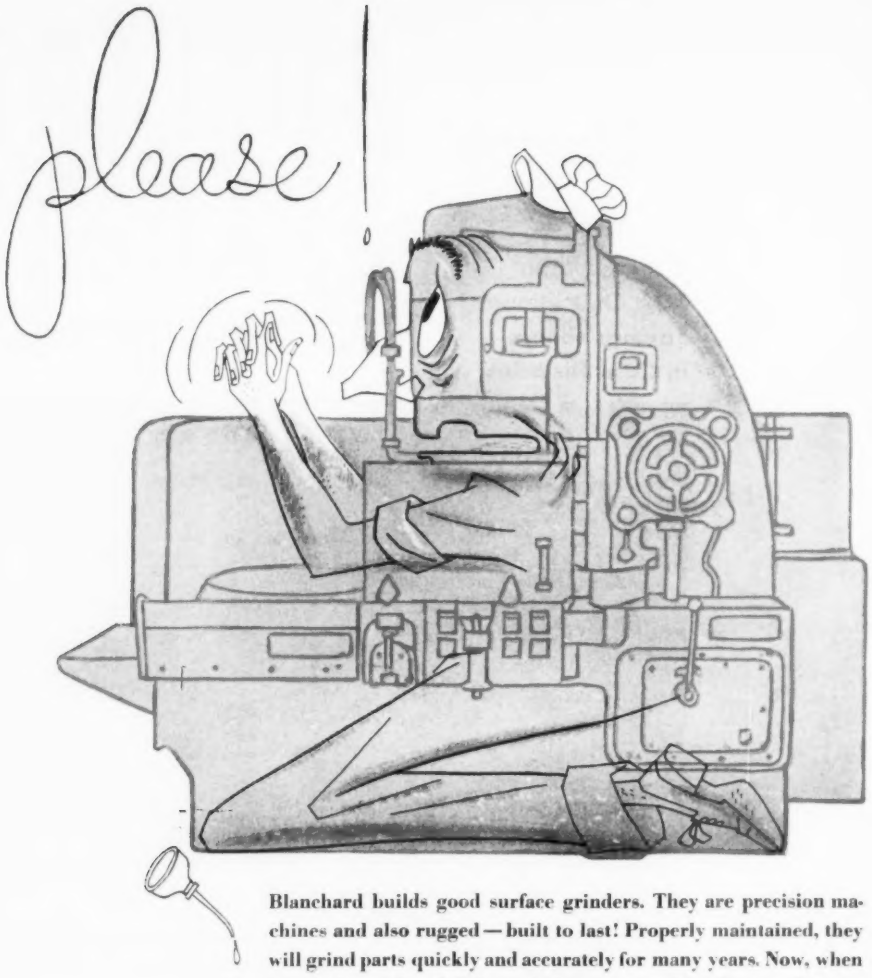
•

WRITE FOR BOOKLET

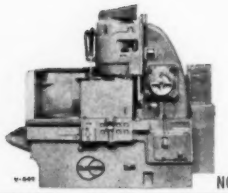
Elimination of time and expense in the design and fabrication of drill jigs is an important factor in lowering manufacturing costs. Maintenance and handling of jigs are also NON-PRODUCTIVE operations. The investment in a **BULLARD SPACER** is quickly absorbed . . .

QUOTE FROM ONE USER: "We have completed some forty (40) different jobs. The amount of pieces of each job is about thirty (30). The cost of making jigs for each one of these jobs would amount to, from $300 to $500 per jig, plus special cutting tools to be used with jig drilling and boring."

THE BULLARD COMPANY
BRIDGEPORT 2, CONNECTICUT



Blanchard builds good surface grinders. They are precision machines and also rugged—built to last! Properly maintained, they will grind parts quickly and accurately for many years. Now, when the urgent demands of defense industries are lengthening delivery dates on new Blanchard grinders, it is vitally important that you take good care of the Blanchards you now have. When operating on two shifts, machines should be cleaned, oiled and greased twice as often—on three shifts, three times as often! Complete maintenance instructions are shipped with every new Blanchard grinder. If you would like an additional copy, just drop us a card giving the serial numbers of your grinders. Taking good care of your Blanchards will enable them to take good care of you!



NO. 18 BLANCHARD SURFACE GRINDER

Send for your free copies of "Work Done on the Blanchard," fourth edition, and "Art of Blanchard Surface Grinding."

PUT IT ON THE BLANCHARD

THE BLANCHARD MACHINE COMPANY

64 STATE ST., CAMBRIDGE 39, MASS., U.S.A.

MODERN PRECISION TOOLS

MODERN COLLAPSIBLE TAPS

Modern Self-Opening Die Heads are available in both stationary and rotary types. The stationary type is made in a range of 4 sizes with capacity for cutting straight threads from ⅛″ to 7″, and ⅛″ to 6″ for pipe threads. Rotary type, straight threads from ⅛″ to 1¼″, pipe threads from ⅛″ to ¾″.

MODERN SELF-OPENING DIE HEADS

Of unusually simple design with a minimum number of parts and no complicated mechanisms, this new Modern Collapsible Tap Style A-A helps meet industry's demand for faster, lower cost production. It is made in a wide range of sizes with adequate capacities for cutting straight threads and straight and taper pipe threads. All parts are of properly hardened steel, ground and precision fitted.

Modern-Magic Quick Change Chuck and Collet Equipment virtually eliminates costly idle time usually present in revolving spindle operations. Tools are changed without stopping or even slowing the spindles. Modern-Magic Chucks are made in 6 sizes and two types: friction drive and positive drive. Modern-Magic Collets are available in a broad range of both standard and special types.

Modern Self-Opening Stud Setters are positive and entirely automatic in action, and can be operated in any position with either air or electrically driven portable tools. Also equally effective in drill presses where it is possible to drill and tap the holes and set the studs in successive operations. Made in two sizes ½″ and ⅞″ capacity.

Modern Medium Duty Face Milling Cutters are of blade backed design, and are made in axial and radial types. Standard Modern axial type cutters are available in diameters from 4″ to 24″. Standard radial type cutters from 8″ to 24″ diameters. All blades, wedges and screws are interchangeable in all Modern Cutters regardless of diameters.

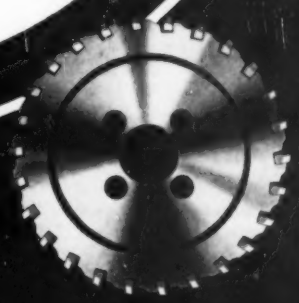
MODERN-MAGIC CHUCKS AND COLLET EQUIPMENT

Detailed information covering any Modern Precision Tool in which you are interested will be furnished promptly upon request. Let us show you how Modern Precision Tools can help to speed up your production and reduce your costs.

Modern Precision Tools Include . . . . .

- STATIONARY SELF-OPENING DIE HEADS
- ROTARY SELF-OPENING DIE HEADS
- STATIONARY COLLAPSIBLE TAPS
- ROTARY COLLAPSIBLE TAPS
- MODERN-MAGIC CHUCKS AND COLLETS
- SELF-OPENING STUD SETTERS
- INSERTED BLADE FACE MILLING CUTTERS
- SOLID ADJUSTABLE DIE HEADS
- ADJUSTABLE HOLLOW MILLING TOOLS
- UNIVERSAL CHASER GRINDING FIXTURES

MODERN SELF-OPENING STUD SETTERS



MODERN FACE MILLING CUTTERS

Modern Precision Tools are produced by the originators of the Modern-Magic Quick Change Chuck and Collet Equipment.

MODERN TOOL WORKS

DIVISION OF

CONSOLIDATED MACHINE TOOL CORPORATION

ROCHESTER 10, NEW YORK

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Here's the great new

NEBEL DISTRIBUTOR ORGANIZATION

Nebel lathes will no longer be sold on an open basis. As a result of this . . . and thru a closer working arrangement between the field and factory, your Nebel distributor can now bring you a new brand of Nebel service . . . plus the complete line of Nebel heavy duty engine, removable block gap and extension bed gap lathes. He's a machine tool specialist . . . he's conveniently located near you. Call him any time for information or service.

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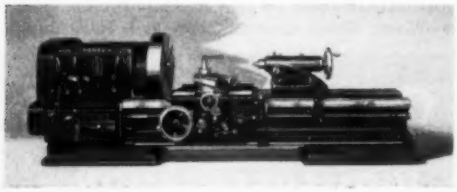


Nebel

THE NEBEL MACHINE TOOL CO., CINCINNATI 25, OHIO, U.S.A.
Manufacturers of basic metal-working lathes since 1899.

This "mirror" is formed by the surface of the exclusive new Fosdick Superfinished Column. So smooth and shiny, a man can actually use it for shaving, it seals out rust and corrosion, virtually eliminates scoring and column wear. Now standard on all Fosdick Economax Hydraulic Radials, the new superfinished column adds to the long life and accuracy of these machines, helps give your drilling costs a *real* shave.

Other features that have made Economax Hydraulics a favorite among Radials include hydraulic centralized controls and safety interlocks, automatic lubrication, the hydraulic non-twist column clamp and many more. Call your Fosdick Distributor today for the whole story or write for Bulletin RDA.

RADIAL DRILLS
SENSITIVE AND UPRIGHT DRILLS
JIG BORERS

THE FOSDICK MACHINE TOOL CO., CINCINNATI 23, OHIO

AUTOMATIC POSITIONING MACHINES
SENSITIVE RADIAL DRILLS

FOSDICK

BANK ON MONARCH-

Cash in these Vital Production Savings

Production—production—more production—that's the pressure today. More and more output is needed, from every machine, operator, kilowatt and square foot. Are you getting work output that *can't be exceeded* by any new production methods—such as those offered by the most advanced types of modern Monarch Lathes? Before you say "Yes", study the Monarch plus values below. Figure how these savings might be translated into improved output for you. Then, let's get down to cases—and let a Monarch sales engineer furnish actual studies on the jobs you've got right now.

★ ★ ★ ★ ★

SAVE VITAL MATERIALS. Scrap losses, especially with unskilled manpower, can be high. Great reductions in spoilage occur when Monarch's duplicating methods replace the human factor in repetitive turning.

SAVE ON SUBSEQUENT OPERATIONS. With less stock left to remove, grinding time is often reduced by as much as 50%.

CONSERVE SCARCE SKILLED MANPOWER. Even green personnel can operate Tracer-Controlled Monarch Lathes, once the job has been set up.

MULTIPLY OPERATOR'S OUTPUT. Case histories show many instances where one Tracer-Controlled Monarch Lathe has replaced three or even four conventional machines. The fact that he can readily run two machines, on many classes of work, doubles the operator's output.

SAVE ON TOOLS. Save time and money on costly form tools—save on tool-sharpening and tool change time with the Monarch Tracer-Controlled single tool metal turning principle. Insert-type tools save even more! Let us show actual figures.

★ ★ ★ ★ ★

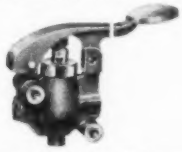
Want to cash in on these Monarch savings? We make a complete line of Production, Toolmakers' and Engine Lathes and *three* kinds of Tracer Controls applicable to most of them—the Monarch-Keller, Air-Gage Tracer and Motor Trace Controls. We'll gladly furnish complete information and data. Just ask us for Booklets, indicating your interests . . . *The Monarch Machine Tool Co., Sidney, Ohio.*

Monarch
ACCURACY • ECONOMY • LONG LIFE
TURNING MACHINES

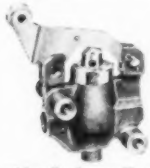
FOR A GOOD TURN FASTER . . . TURN TO MONARCH

Schrader **Valves— Practical answers to air control problems**

To meet the vast and increasing variety of applications for air cylinders and other air line accessories, Schrader supplies a comprehensive range of equally useful control and operating valves for operation by hand, foot or cam. Shown below are just a few from Schrader's more than a hundred models.



Hand Lever—This is one of the many Schrader hand operated valves. Brass body with stainless steel parts. Can be mounted rigidly at any angle. Specially constructed lever makes operation easy and



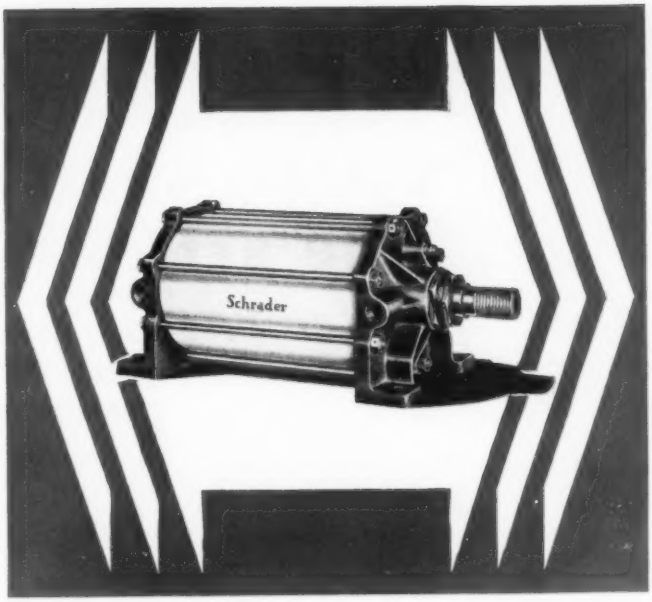
Valves with roller lever—These valves are designed for any cam actuation. The free turning roller riding on a cam provides long life by reducing friction.

Pilot valves—Both two and three way, with or without timer. Normally open or normally closed. Provides instant power at remote points.

Foot Lever—This valve supplies line pressure to single acting cylinders. It is functionally designed for "tip-toe" operation.

Air Cylinders • Operating Valves • Press & Shear Controls • Air Ejection Sets • Blow Guns • Air Line Couplers • Air Hose & Fittings • Hose Reels • Pressure Regulators & Oilers • Air Strainers • Hydraulic Gauges • Uniflare Tube Fittings

Schrader
PRODUCTS
CONTROL THE AIR



Four ways that air cylinders can increase production in your plant

You can make hard work easy, eliminate manual effort and speed up production by the application of air power . . often the best, usually the economical way to apply force where you need it. For example:

- ***To provide a powerful push***
- ***Where clamping is necessary***
- ***For lifting operations***
- ***To power a reciprocating motion***

Schrader Air Cylinders are increasing production through safer, faster and less fatiguing operations, in many thousands of applications in plants throughout the country.

Undoubtedly there are many places in your own plant where Schrader Air Cylinders will be just the thing. Ask us to help you determine what will best fit your needs. Send us a letter outlining your particular requirements, your idea, or fill out the coupon below.

Mail This Coupon Today

A. Schrader's Son
Division of Scovill Manufacturing Company, Incorporated
460 Vanderbilt Avenue, Brooklyn N. Y., Dept. F-3

Please send me further information on the Schrader Air Cylinders and Valves.

Name _____ Title _____

Company _____

Address _____

City _____ Zone _____ State _____

KELLERFLEX

FLEXIBLE SHAFT MACHINES

GIVE YOU BETTER FINISHING

with greater ease . . . at lower cost

THE VERSATILE *"Series M"* MACHINE

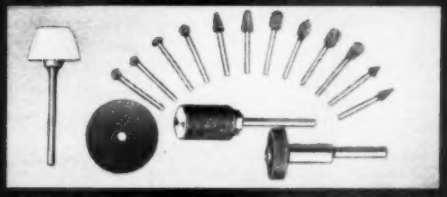
Use it anywhere in the shop . . . as a Floor Model, Bench Model or Suspension Model. Use it for power, for flexibility, for doing a better job faster, with less fatigue, at less cost.

16 constant shaft speeds — ranging from 1,000 to 6,000 or 2,000 to 12,000 rpm. Uses ¼, ⅓, ½ or ¾ hp motor.

A still wider range of speeds — ratio 1:3 — can be obtained by using Kellerflex High Speed Attachment.

THE SPEEDY JB-O MACHINE

Use P&W dental-type cables and handpieces for smaller work, and the standard JB-O cables and handpieces for the larger jobs. Either way, the JB-O features ample power and speeds from 800 to 9,000 rpm, or 2,500 to 10,500 rpm—without slow-downs or stops. Uses ⅛ hp motor.



Whatever the job—there's a P&W Tool to do it better. Recommended for the JB-O Machine is a full line of P&W Finishing Tools, including all shapes, sizes and kinds of HSS Burs, Carbide Burs, Grinding Wheels, Sanding Drums, Wire Brushes, Polishing Wheels.

Get full details on the "Series M" and the JB-O — and their accessories and attachments — from this single source of supply. Call any nearby P&W Branch Office at . . .

Birmingham • Boston • Chicago • Cincinnati
Cleveland • Dallas (The StancoCo.) • Detroit
Houston (The Stanco Co.) • Los Angeles
New York • Philadelphia • Pittsburgh
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PRATT & WHITNEY

Division NILES-BEMENT-POND COMPANY

WEST HARTFORD 1, CONNECTICUT, U. S. A.

Dedicated to Accuracy for 91 years

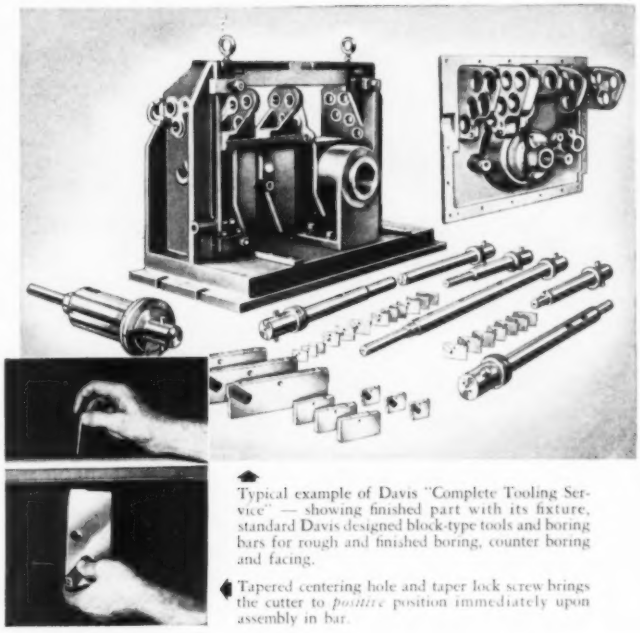
SAVE UP TO 50%
in over-all boring time

Davis Block-Type Cutters Eliminate Trial Cuts and Extra Adjustments

There's no time wasted taking trial cuts and resetting cutters several times to get a bore size. Operators can quickly duplicate at the machine accurate settings established in the tool room.

What's more, using Davis block-type cutters — you can bore different sizes, face, chamfer and counter-bore one or more holes on the same axis in a single operation! If you want to change tools — simply slip out one block — slip in another — quick and easy like changing a razor blade.

Especially on turret lathes—Davis Multiple-Cutters save time! One Davis multiple cutter completes boring, counter-boring, reaming, chamfering and similar cuts in a simple indexing of the turret.



Typical example of Davis "Complete Tooling Service" — showing finished part with its fixture, standard Davis designed block-type tools and boring bars for rough and finished boring, counter boring and facing.

Tapered centering hole and taper lock screw brings the cutter to *positive* position immediately upon assembly in bar.

Davis "Complete Tooling Service"

Increases production... lowers cost... gives you greater flexibility of equipment

Davis "Complete Tooling Service"—backed by a world-wide sales and service organization — offers you a full line of standard boring tools (capacity — any diameter from ¾" to 54") . . . plus design and construction of special tools to meet your particular requirements.

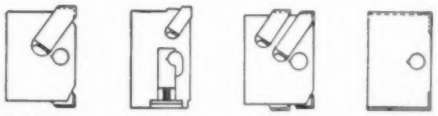
Davis maintains a large staff of design engineers and field servicemen to aid you in every phase of efficient tool selection.

Now you can standardize your whole shop on one complete line of modern tools . . . count on one dependable source of supply and engineering help . . . share in the very latest developments in tool design. You can realize all the advantages of the Davis "Complete Tooling Service"... increased production, lower costs and greater flexibility of your equipment.

Check This Full Line... Send For Catalogs

1. Block-type boring tools.
2. Micrometer-type boring tools.
3. Micrometer adjustable block-type boring tools.
4. Fly-cutter-type boring tools, SUPER micrometer.
5. Stub boring sets, SUPER micrometer.
6. Boring heads (standard or special).
7. Planer tools.
8. Vertical boring and turning mill tools.
9. Quick-change arbors, sleeves and spindles.
10. Line boring bars (standard or special).

DESIGNED FOR EVERY BORING AND REAMING REQUIREMENT



Regular Type | Single Cutter Micrometer Type | Multiple Cutter Type | Solid Type Block Cutter

DAVIS BORING TOOL

Division of GIDDINGS & LEWIS MACHINE TOOL COMPANY • Fond du Lac, Wisconsin

World's Largest Builder of Horizontal Boring, Drilling and Milling Machines • Planer-Type Milling Machines • Large Vertical Boring Mills

ARMSTRONG

Modern Tooling Calls for *the Correct*

ARMSTRONG TOOL HOLDERS for each operation

In the old days it was a matter of pride with toolmakers to be able to do the work at hand with the tools at hand. It's a credit to their skill that they could devise to cut threads, do cutting-off and facing, as well as many other operations with one ARMSTRONG TURNING TOOL, but, at today's labor cost, this would be an expensive practice. The maximum of productive work and true machining efficiency can only be obtained by providing the correct ARMSTRONG TOOL HOLDERS for each operation.

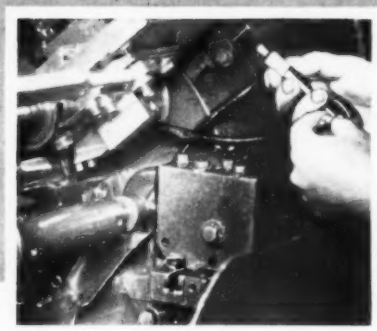
The Armstrong System of Tool Holders provides specially designed ARMSTRONG TOOL HOLDERS for every operation on lathes, planers, slotters, and shapers . . . Turning Tools, Boring Tools, Threading Tools, Knurling Tools, Cutting-Off Tools; tool holders with straight shanks, with off-set shanks, rigid tools and "spring" tools . . . special tool holders for high speed steel bits or blades, for ARMIDE (carbide-tipped) Cutters, for ARMALOY (cast alloy) Bits and Blades.

These modern efficient ARMSTRONG TOOL HOLDERS are as available as your telephone for they are carried in stock by your local ARMSTRONG Distributor.

ARMSTRONG BROS. TOOL CO.

"THE TOOL HOLDER PEOPLE"

5215 W. ARMSTRONG AVENUE **CHICAGO 30, ILL.**



Spells "finish" for another cutting problem

HERE'S the problem one midwest manufacturer posed to a Standard Oil lubrication specialist: improve the finish of steel valve seats produced on an automatic screw machine *and* reduce cutting oil costs.

STANICUT Cutting Oil 117 BCS was recommended and put to work. The problem was solved on both counts since STANICUT resulted in a finer finish on the valve seats and cost less than the oil previously used. Plant operators found a *bonus* advantage in STANICUT when records revealed longer tool life. That meant lower tool costs and less downtime for tool changes . . . additional economy in the cost of machining these parts.

In this case STANICUT replaced a single, more expensive cutting oil. In plant after plant, however, STANICUT has proved so versatile that it has replaced a variety of conventional oils, often serving every operation in the shop or department.

There is a Standard Oil lubrication specialist at your service wherever you are located in the Midwest. For his help in selecting a better cutting oil for your operation (or operations) contact your local Standard Oil office or write:

Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

STANICUT
TRADE MARK
Cutting Oil

What's your problem?

D. J. Clark, of Standard Oil's Saginaw office, is the lubrication specialist who recommended STANICUT in this case, and thereby not only solved the problem at hand, but made additional savings possible for the manufacturer.

His on-the-job service is typical of that available to all midwest plants through a corps of such specialists. You can be sure that the specialist in your area has both the practical experience and the training in a Standard Oil Lubrication Engineering School that will result in dependable, thorough assistance.

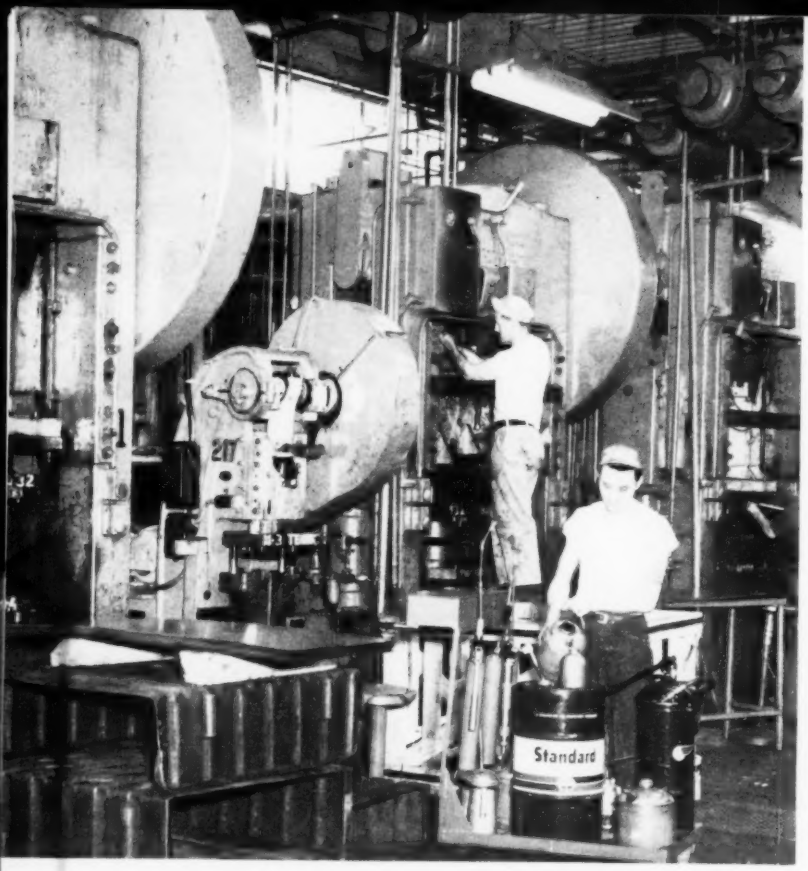
A post card or phone call to your nearest Standard Oil (Indiana) office is all that's necessary to put a Standard lubrication specialist to work on your problem. When he calls, be sure to discuss the advantages and performance records of these outstanding products:

STANICOOL HD Soluble Oils Because they contain additional compounding, these heavy-duty soluble oils possess not only the cooling ability of an emulsion but also the ability to give better tool life and finer finishes than can be obtained with a conventional soluble oil.

STANOSTAMP Compounds Here are three established products for stamping or heavy drawing operations of either low-carbon or alloy steels. Water can be added to these paste compounds to provide the most economical applications. STANOSTAMPS offer maximum protection for dies and work. These compounds can be readily removed in conventional washing equipment.

STANDARD OIL COMPANY

STANDARD *(Indiana)*



No drips in this press room

WHEN plant maintenance personnel, headed by Mr. Fred Melby, Maintenance Superintendent, of the A. O. Smith Corporation Kankakee Works tested STANODRIP Dripless Oil No. 59 on the recommendation of a Standard Oil lubrication specialist, they found the solution for press room lubrication troubles.

STANODRIP ended the drippage of oil from bearings on stamping and punch presses. That meant cleaner and safer working conditions, less lubricant consumption, and fewer lubrication applications. As a result, STANODRIP is now used throughout the press room and is being adopted by other departments as well. "Reduced maintenance costs and longer life of our equipment are definite advantages . . . ," says Fred Melby, Plant Maintenance Supervisor.

To help put STANODRIP Dripless Oils to work wherever leakage or drippage is a problem . . . or for assistance in all phases of industrial lubrication . . . call in the Standard Oil lubrication specialist in your area. Contact your local Standard Oil Company (Indiana) office, or write: Standard Oil Company (Indiana), 910 South Michigan Ave., Chicago 80, Ill.

Stanodrip
REG. U.S. PAT. OFF.
Dripless Oil

What's your problem?

C. B. Eggen of the Standard Oil office in Joliet is the specialist who helped solve this press room lubrication problem for A. O. Smith Corporation.

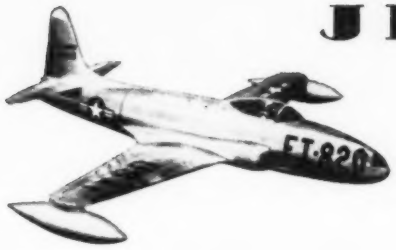
With a broad background of practical experience and special training, his service is typical of the assistance available to plants located everywhere in the Midwest. Like others in the corps of Standard Oil lubrication specialists, he makes his headquarters near the plants he serves.

To take advantage of prompt, on-the-spot service in your own plant, phone or write the Standard Oil office in your area. When the lubrication specialist calls on you, be sure to get full information on these fine Standard Oil products:

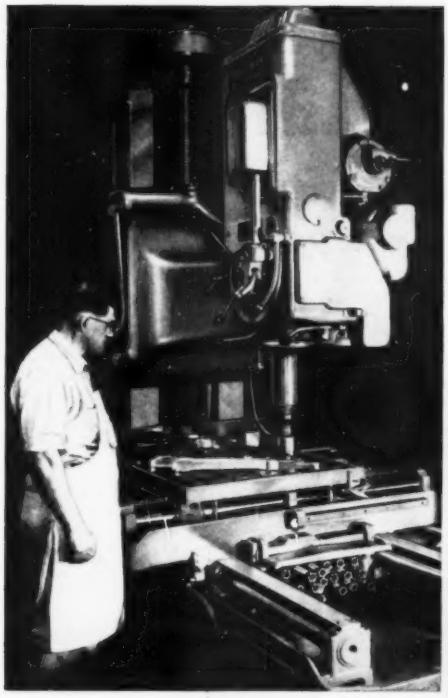
CALUMET Viscous Lubricants — These greases strongly resist washing and throw-off. Their superior wetting ability affords better coating of open gears and chains, better internal lubrication of wire ropes.

STANORUST Rust Preventives — The eight grades of STANORUSTs form one of the most complete and effective lines of rust preventives available. Each has been scientifically developed for its intended use. The grades range from a fingerprint remover to a heavy petrolatum that protects against corrosion for years under the most severe outdoor exposure.

STANDARD OIL COMPANY STANDARD *(Indiana)*



JIGLESS ACCURATE DRILLING



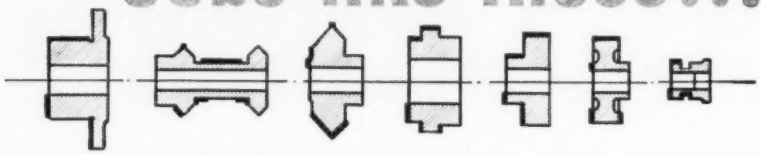
Precision production work without the use of jigs, at Lockheed, is now being accomplished on the Cincinnati Bickford PRECISION Drilling Machine, equipped with a Bullard Man-Au-Trol Spacer. A variety of production jobs, such as cutting holes approximately 3" in diameter, through curved plates of magnesium about $\frac{3}{8}$" thick, are now being economically produced without the use of jigs. First, a $\frac{5}{16}$" hole is used as a pilot hole for a fly cutter. The total tolerance on the diameter of the accurately located holes is .001". According to Lockheed, "Fast, repetitive drilling is handled without the use and expense of jigs — heavy parts including castings are automatically positioned under the jig boring type spindle — parts handling is minimized — storage and maintenance of drill jigs are eliminated."

Where repeated accuracy of hole spacing, drilling, reaming and tapping is to be economically facilitated, the combination of the SUPER SERVICE PRECISION Drilling Machine and the Bullard 30" x 20" Spacer is hard to beat. Not only is production speeded — there is no waiting for jigs to be made. You can get into production of vitally needed parts right away.

Ask the Cincinnati Bickford Tool Company, of Cincinnati 9, Ohio, or the Bullard Company, of Bridgeport 2, Connecticut, for further information about this natural combination.

THE CINCINNATI BICKFORD TOOL CO. Cincinnati 9, Ohio U.S.A.

Jobs like these...



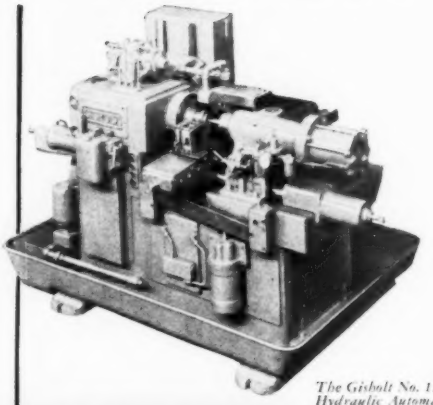
on a Job-Lot basis...

on Automatic Lathes?

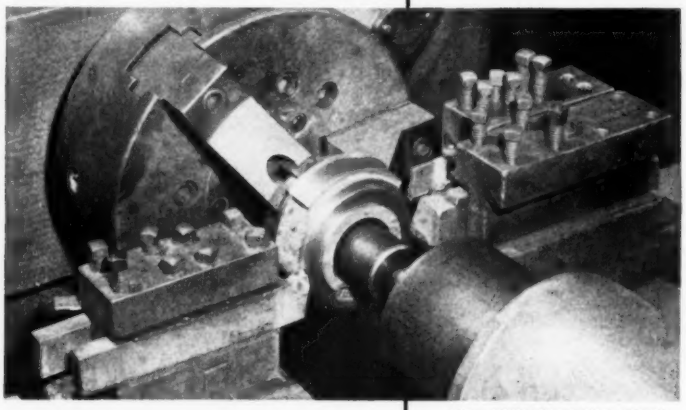
Absolutely! And these are only 8 of over 200 actual small-lot jobs handled on Gisholt No. 12 Hydraulic Automatic Lathes. The Crompton and Knowles Loom Works of Worcester, Mass., has *four* No. 12 Hydraulics busy producing and saving on work like this . . . and all with standard tool blocks!

Job-lot work like this—and like yours—is a natural for the No. 12 Automatic. The cost is no more than a hand-operated lathe for work this size . . . yet you have the added advantages of automatic machining and one-man operation of two or more machines.

If you have contract work like this, now or pending, it will pay you well to get the facts on the No. 12 Hydraulic Automatic Lathe. There's a big 24-page catalog free for the asking.



The Gisholt No. 12 Hydraulic Automatic Lathe gives you speed and accuracy plus easy set-up.



GISHOLT MACHINE COMPANY
Madison 10, Wisconsin

THE GISHOLT ROUND TABLE
represents the collective experience of specialists in the machining, surface-finishing and balancing of round and partly round parts. Your problems are welcomed here.

TURRET LATHES • AUTOMATIC LATHES • SUPERFINISHERS • BALANCERS • SPECIAL MACHINES

Tool Steel Topics

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation

How the Right Steel Solved These 3 Tool Problems

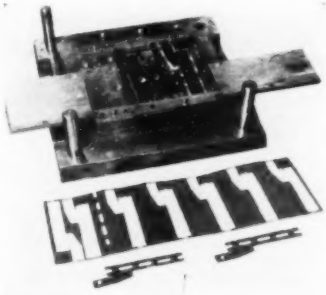
Our metallurgical servicemen and distributors are constantly on the job to help users get the most out of their tool steel. Here are the highlights of some recent tool problems solved by selecting a more suitable steel.

A MAKER OF AUTOMOBILE BUMPERS had been getting poor service from shear blades for trimming hot-rolled spring steel. High-speed steel didn't wear long enough and the cutting edge peened. High-carbon, high-chromium tool steel (our Lehigh H) was tried next. It had plenty of wear-resistance, but the cutting edges developed chipping trouble. **SOLUTION:** Our man suggested Lehigh L (a high-chromium grade with lower carbon). This worked fine — because it had sufficient wear-resistance combined with more toughness.

AN AIRCRAFT FIRM WAS BOTHERED by the cracking of some special wrenches for assembling aircraft parts. The wrenches had very sharp corners, and both thin and thick sections. The application called for plenty of toughness and a fair amount of wear-resistance. The firm had been making these wrenches from a low-carbon type of silico-manganese tool steel, and they were cracking in the water-quenching operation. **SOLUTION:** We recommended Omega. With its less drastic oil-quench and inherent toughness, it has licked the cracking trouble.

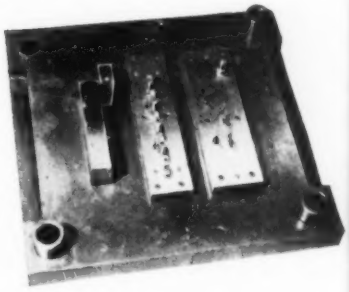
A SHEET-METAL FABRICATOR COMPLAINED to a Bethlehem salesman about the premature breakage of small-diameter punches. Rather long and slender, the punches were used on sheet steel of greater thickness than the punch diameter. (It's usually best for the punch diameter to be greater than the thickness of material being punched.) The punches were subjected to excessive side thrust; constant breakage was running up production costs. **SOLUTION:** They tried 67 Chisel, our chrome-tungsten grade of shock-resisting tool steel. Result: Punches produced about eight times as many blanks as previously.

Die turns out 500,000 pieces . . . and still going strong



This progressive die, made of BTR, performs a perforating, notching, and blanking operation in the production of condenser brackets. This popular grade of oil-hardening steel was selected by the user because it's easy to heat-treat . . . it has good resistance to distortion in heat-treatment and it's easy to machine.

The long-wearing qualities of BTR are evidenced by the production of more than a half-million pieces at the time the photograph was made. Hardened to Rockwell C-59, it produces about 30,000 parts from 3/32-in. steel strip before redressing is needed.



Our Tool Steel Engineer Says:

Rapid wear is caused usually by improper heat-treatment

When tools fail by wearing too rapidly, the trouble can usually be traced to inadequate heat-treatment resulting in decarburized surfaces, improper quenching that produces low hardness, and other faulty procedures.

However, poor wear-resistance may also result from the use of the wrong type of tool steel. If a blanking die is made of a 0.60 pct carbon steel of the shock-resisting type, it can't be expected to wear as long as a 1.50 pct carbon steel having a high chromium content.

NEW USE FOR HIGH-SPEED STEEL

An enterprising apprentice in a tool shop stumbled on a small cache of round steel bars the other day. They were just the right size he needed for a small storage rack the foreman had asked him to build. He made a nice job of it. "This ought to make a hit with the foreman," he thought as the last bar was fitted into place.

When the foreman took one look at the rack, he recoiled in horror. "Oh, no!" he groaned. To the puzzled apprentice the foreman growled, "Young fella, that rack you've got there is worth about ten times the cost of the carbon steel bars it's going to hold. Looks like you've used up every piece of my high-speed steel."

Bethlehem ULTRASONIC TESTED **Tool Steel**

"I told you not to let him in! He has a grip like a JACOBS CHUCK!"

IF IT'S A

JACOBS

IT HOLDS

THE JACOBS MANUFACTURING CO., WEST HARTFORD 10, CONN.

Backlash

EXTRACTS FROM CURRENT LETTERS TO THE EDITORS

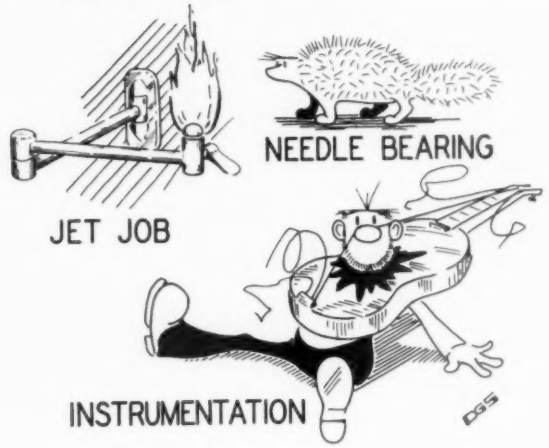
Who Pays?

H. Waring (*AM*, p110, Sept. 17) would Oslerize or New Dealize the fellows who have reached age 65. It would be fun to discuss this at some length, but suffice it now to say that he is somewhat of an optimist if he thinks the present economic trend can continue and at the same time he can accumulate a competence to keep him the balance of his days in the grandeur to which he will have become accustomed. Shiny bubbles have a peculiar way of distorting the images seen on their surfaces. Somebody is today releasing a lot of excess CO_2 into a sea of soft soap. Call it what you will, a lot of unborn children will either be paying a hell of a price for our excesses, in taxes or in the misery of a chaotic civilization that will not bear much resemblance to our mental images of the good things of life. It would seem that Mr. Waring has picked out one facet of the gem we call life, and proposes to enlarge it without regard to how it will affect the fine balance of proportions that make any gem really valuable. He forgets that life begins when some man presses the switch, briefly, that sends forth a wave of power that, when it becomes visible, we call a man. He forgets that for fifteen years or thereabouts this new man should be spending his time industriously enlarging his capacity for living, and that for a period thereafter, length unknown, he should be gradually assuming the stature and duties of adulthood. By this time he will have reached the portion of the picture Mr. Waring sees.

At the edge of the rock of life, Mr. Waring would have a high cliff from which those at the head of the column would be unceremoniously pushed, forgetting that there can be a gentle slope down to the vast expanse of the sands of time into which we must eventually disappear, regardless of the path we have followed getting there. Mr. Waring seems to be standing like an Atlas, flexing his hardened muscles for all the world to admire, rather than looking down toward those laboriously climbing toward the top with a thought of giving them a helping hand. Neither can he see any value to be had from the wonderful views of the sunset of life that can be seen only from the long gentle climb down from the pinnacle. He is living too close to the inanimate masses of

GRINETICS

BY D. G. SMITH



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COMTORPLUG

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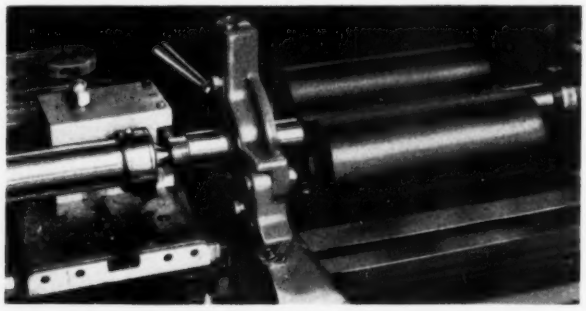

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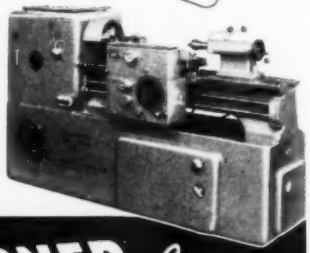

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material he sledges into shape day after day, scrapping them as soon as they have served their brief period of usefulness.

Life is more than mere grasping for wealth or acclaim. It is lending the helping hand to all about us who are less well situated. It is practicing the Golden Rule as promulgated by Christ, rather than as given by Confucius. It is "Do unto others what you would have others do unto you," rather than "Do not do unto others what you would not have others do unto you." It is dynamic but not covetousness. Mr. Waring has confused the two in his thinking, or at least that part that he has put into words.

Arthur B. Clay
North Canton, O.

Argentine Industry

We are considering establishing an industry for the manufacture of steel wood screws in this country and would be much obliged if you would advise us where we might obtain suitable equipment. We should like to know the cost of such machines and would appreciate your obtaining illustrated catalogs and prices for us.

A. J. Dardano
Rosario, Argentina

We have forwarded your inquiry to the H. P. Townsend Mfg. Co., Elmwood, Conn. That company is sending pertinent literature, and is instructing its local agent to contact you. — Ed.

Practical Ideas

I have a suggestion to make concerning AMERICAN MACHINIST, and would like to know what you think of it. It concerns Practical Ideas.

We, at work, and others, I believe, find this section very handy and helpful and would like to keep a file of them. I would like to suggest that you serrate the pages so they

Quartz.....Formica....Copper Tubing?

INGENIOUS Delta SET-UPS CUT THEM ALL

Cutting Quartz

National Scientific Products Co., Chicago, built a special mounting for Delta 14-inch drill presses, and fitted them with abrasive wheels, to cut wafer-thin quartz crystals for communication instruments. Side-mounted, pivoted drill press heads are actuated by a hydraulic-cylinder power feed. Curtain prevents lubricant splashing.

Cutting Copper Tubing

LeRoi Co., Milwaukee, fitted an adjustable reel to a Delta cut-off machine to cut copper tubing to length. Reel cuts handling time and labor costs, and permits under-bench storage of a variety of sizes.

Faced with problems of machining out-of-the ordinary materials, many shop superintendents and tool engineers have found the solution by adapting low-cost, high-precision Delta wood and metal working machines. Here are typical examples:

Cutting Formica

Boothcraft, Inc., Jamestown, N. Y., cuts Formica for restaurant counter and table tops on Delta Unisaws. Boothcraft also uses Delta disc sanders for finishing the edges of sheets of Formica, which has a hardness approaching steel.

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can easily be removed, and also start the article on a right-hand page.

Chester Weymier
Milwaukee, Wisconsin

Sorry we can't oblige, but postal regulations for second-class mail do not permit us to perforate pages for easy removal. As to starting on a right-hand page, that depends on the number of pages we use for this section. If there are five pages, as is usual, a left-hand start must be used because of the location of the Reference Book Sheets and the way the magazine is made up at the printer's.—Ed.

Any Ideas?

I have read with considerable interest the description of how International Harvester trains its foremen. The plan sounds excellent, and I have no doubt it works very well for a big outfit like Harvester, but has anyone come up with a practical way of training foremen for the small plant?

Obviously, in a shop with only a couple of hundred men, we cannot afford the time and expense of putting such an elaborate program into operation. Nor would we have enough prospective foremen in training to justify such a plan.

We like to make promotions within our own organization, but what are we to do when we don't have natural-born foreman material available? There may be several men who would be likely prospects if it were not for one or two defects, and if we could afford a program like Harvester's we could eliminate these faults and make top-notch leaders out of them. As it is, we have to do the best we can and hope it will work out all right. Does anyone know of a workable plan for the small shop?

Another point that looks bad to me is the limit of 35 years of age for a foreman's appointment. What chance is there for a good man who came into the plant late in life?

R. B. Cobby
Minneapolis

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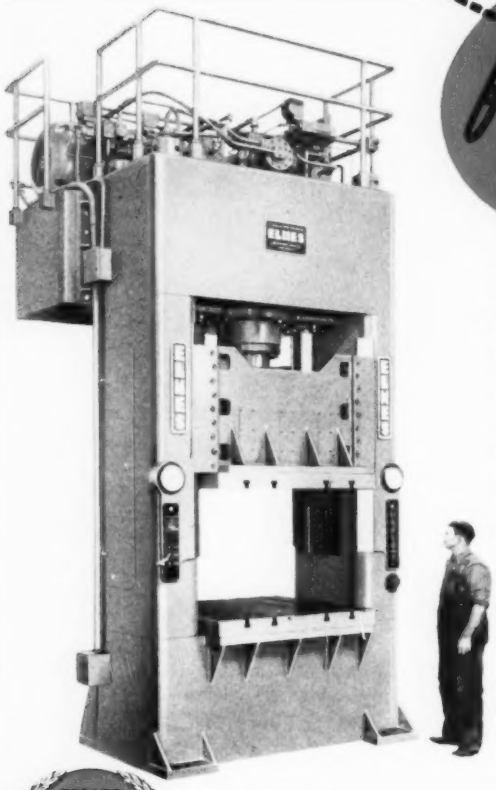

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The new press shown here is typical of Elmes *specialized design.* Developed specifically for the manufacture of plow beams, this press has a special hydraulic circuit providing *two pressure cycles in one.* Operation is by electrical control, using two foot switches. By actuating one foot switch, the ram is made to exert low tonnage for bending the plow beams to a specific angle; the beams are then turned and flattened under high tonnage by operating the other foot switch. The press is arranged for pressure reversal as well as position reversal.

Conveniently located controls speed press operation and die set-up time. Limit switch controls are operated by means of a simple hand crank. Inching-down handwheel permits the operator to move the platen as little as 1/16" at a time—a great aid to precise control in die-setting. A desirable safety feature is a thermostat control which will stop the press operation in the event hydraulic fluid should reach a critical temperature.

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SPOT NEWS of Metalworking

- **To save materials and manpower, limitation orders on electric controls and on paint for new** machine tools are to be issued soon by National Production Authority. Electric controls are to be limited to the standards set up by the National Machine Tool Builders' Association. Builders are to be restricted to two coats of paint on new machine tools.

- **Pentagon is worried over union demands** that defense contracts be given only to closed shops. Construction workers started this action, with work stoppages. They demanded that procurement regulations be modified to read that contracts be given to the lowest "responsible" bidder, with responsible bidder being defined as a union bidder. Such action would require Congressional amendment to the Armed Services Procurement Act of 1947.

- **Army Ordnance Corps is adopting as standard new greaseless pack** for machine guns, other small arms and rifles. New envelope contained can be peeled off in a matter of seconds. Pack consists of outer layer of cotton srim, layer of plastic-coated aluminum foil and inner sheet of Kraft paper coated with VCI (volatile corrosion inhibitor).

A 24-million-volt betatron for inspecting steel sections up to 24 in. in thickness was shown at National Metals Show by Picker X-Ray Corp. Inspection unit is mounted on bridge crane for flexibility.

- **Brooklyn Navy Yard is booked up to its present available machining capacity** on machine tool and tank components for defense program. Philadelphia Navy Yard is planning similar work on light and medium machine tool components. Long Beach, Calif., Yard is to machine parts for mechanical and hydraulic presses. Portsmouth, N. H., Yard has available 10 men for making patterns for machine tool builders.

- **Ship construction program has been cut almost in half** because of lack of steel. "Stop" orders have been issued on 14 ships as follows: Bethlehem Pacific Coast five ships, New York Shipbuilding three, Bethlehem Sparrows Point two, Ingalls two; and one each at Newport News and Bethlehem Quincy. That leaves 21 cargo vessels under construction in ocean-going yards, 22 tankers, one troop ship and one passenger liner.

- **Electric drilling is expanding,** with Elox Corp. a new entry in the field. Its "Electron" drill cuts internal or external shapes into carbides, cast non-ferrous alloys (like Stellite and Tantung), hardened tool steels. It also can produce contoured punches, tapered sections and counterbored holes. Unlike Method X Co., Elox Corp. sells its machines outright, does not lease them.

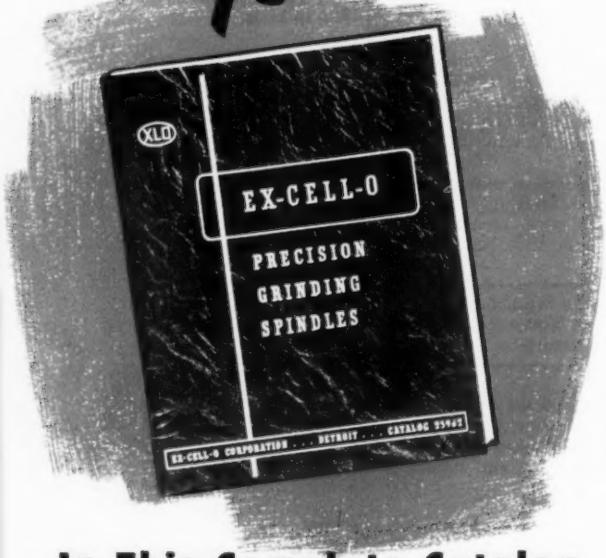
Titanium carbide is now being used experimentally as a material for gages for inspecting titanium parts. Benefits are: better wear-resistance and expansion characteristics similar to the pure metal.

- **Defense strikes are worrying Mobilizer Wilson** because U.S. Conciliation Service is letting them run too long. To speed certification of strikes to War Stabilization Board, unit has been set up by DPA to keep Mr. Wilson informed on effect of actual or threatened strikes.

- **Wage Control Board's regulation approving wage increases** to correct interplant inequities up to "stabilized level" of wages doesn't mean much. Real payoff will be the board's instructions to regional boards on how to determine "stabilized level."

- **North American Aviation has developed new method of making photographic templates** for speeding process engineering. Glass cloth is coated with a fluorescent material, then an overcoat of opaque material. Drawing then is made with a stylus through the opaque material and is given X-ray treatment. Thereupon the fluorescent material glows through where the stylus has scratched, and glass cloth is held in close contact with a sheet of light-sensitized metal. Metal is then developed like a snapshot print and taken to the shop to be cut out. Time: less than 20 minutes.

The Spindle You Want



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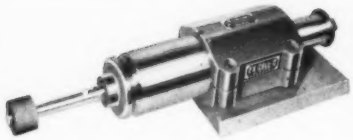
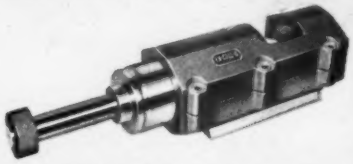
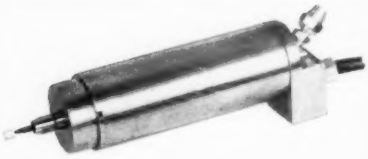


Single-body, belt-driven internal grinding spindle.



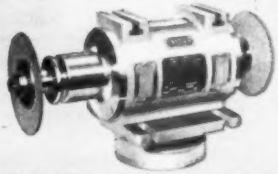
Double-body, belt-driven internal grinding spindle.



65,000 rpm high frequency inbuilt motor spindle.

25,000 rpm high frequency inbuilt motor spindle.

Totally enclosed inbuilt motor surface grinder spindle.



Precision inbuilt motor spindle for cutter grinder.

Vertical precision spindle with inbuilt motor.

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Washington

Big squeeze on consumer durables output starts in first quarter of next year. You can see that in materials allotments for January-March.

Autos, big appliances will drop to about half the pre-Korea production rate. They'll get enough steel, but will have to shave their use of aluminum, copper to hit that level.

That means substitution on a big scale—for the first time. Big shift will be from copper. Aluminum won't be so tight later next year, so no one is going to give up on that.

Some businesses will fold—at least temporarily. The 15% of copper, aluminum allotted for makers of venetian blinds, ash trays, some other "non-essentials" is just enough to let them wind up operations in the first quarter.

• • •

Most other non-military production was cut back on materials, too. Soaring military demands are the big reason, but the controllers also want to force the use of big inventories they believe most industries have on hand.

Tougher inventory regulations will back up this push to whittle down metal stocks, make industry live on quarterly CMP allotments. No cut will be made in inventory limits, but fuzzy wording, loopholes will be eliminated.

• • •

Key industrial demands got a better break on CMP metal for January-March. Makers of general components got nearly 15% more copper—a bottleneck material—than in fourth quarter. And there was over 20% more copper for metalworking machinery and equipment.

• • •

More realistic allotment of steel is in the works. DPA, prodded by steel producers, hereafter will screen reported requirements with aid of a group of experts from the steel industry.

Steel men squawked to Mobilization Boss Wilson about requirements handed to DPA by claimant agencies as absolute minimum needs. They ran up to 205% of structural steel supply, 180% of plate, for example. DPA accepted steel makers' offer help find the "padding."

• • •

If you want tax relief for plant expansion, file your application before starting work on it. After Nov. 1, DPA will turn down requests for five-year amortization on new plant that is under construction.

That's part of new policy on fast amortization. Tool makers get the top rating on list of producers whose applications will get priority handling by government. Even ahead of producers of basic raw materials and military end items.

Priority list for fast amortization will shift from time to time to get more production of different items as new bottlenecks occur. You can still file for plant not on priority list, but you'll have a long wait.

• • •

Newest little business champion in Washington is Small Defense Plants Administration. It's headed by Telford Taylor, New Deal lawyer who prosecuted German war criminals. He was an official of SDPA's War II predecessor, the Smaller War Plants Corp.

SDPA may cut a wide swathe. It has authority to represent small business on controls policy, loans, defense orders, materials.

• • •

Engineers will not be exempted from salary controls. The salary control board feels this would not produce more engineers, only stimulate free-for-all pirating and bidding up of salaries.

Instead, the salary board will try to stabilize the situation, keep engineers where they are or let them move where most needed. It might set time limits between raises or promotions.

• • •

If workers strike for an unlawful purpose—for example, to get closed-shop conditions banned by Taft-Hartley—they forfeit any legal right to their jobs when the strike ends.

That is what the National Labor Relations Board held, for the first time, in a decision involving Mackay Radio & Telegraph Co.

This should not be confused, however, with demands for wage increases higher than approved limits. The Wage Stabilization Board says employers and unions can "agree" on any increases, but may need approval to pay some of them. Keep this in mind: There is no limit to what wage increase or fringe benefit WSB can approve.

• • •

NLRB's latest decision on free speech that stirred up such a fuss among employer groups will not affect the average shop—if NLRB sticks to it.

The board ruled that Bonwit Teller department store must give the union a chance to answer the management's anti-union speech to employees in the store and on company time.

But NLRB made clear its reasons: The story had a rule against union solicitations at any time in the store, yet violated the rule itself by an anti-union campaign. Bonwit Teller has asked the courts to reverse NLRB.

• • •

Union shop authorization elections are a thing of the past. Congress killed them in its first revision of Taft-Hartley. Both Taft and Humphrey—senators with opposite views on the labor law—sponsored the change. It shows the law can be improved, where needed.

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Detroit

Auto production quotas for the first 1952 quarter now seem set, at least as much as anything is set in this regulated age. The quota: 930,000 cars from allotted materials, plus 76,000 others estimated producible from inventories to be carried over from 1951. That 1,006,000 total is about 10% off from the fourth 1951 quarter.

In addition some 250,000 truck assemblies would be permitted.

• • •

When Detroit heard the news it screamed. The auto men themselves said an inventory carryover of 76,000 cars was not feasible—that practically all fourth-quarter shipments of key materials were on allocation, would be used in production by Jan. 1.

The auto people generally said they'd be lucky to make the whole 930,000 assemblies permitted.

They had nothing but snorts of contempt for Washingtonians who proposed making lighter cars, thus stretching tonnage allocations. For one thing, they noted, changing models takes plenty of time. For another, they claimed, allocations were based on fixed numbers of specific models—aren't transferable.

And — over and over and over again — they wondered what was becoming of all the steel they couldn't get.

• • •

The CIO Auto Union forecast more idleness. Its analysis: Some 23,000 Detroit workers will become unemployed and stay unemployed, even after new defense jobs opened up. That would put the roll of jobless in Detroit proper up above 100,000, by these particular sets of figures.

• • •

UAW is doing a far more successful pressure job in Washington than the auto makers. When Walter Reuther nudges Manly Fleischman, or Mr. Truman's secretariat, or the ebullient new Michigan senator, ex-newsman Blair Moody, he gets a quick reaction. Labor carries weight.

• • •

Meanwhile, current production continues fairly good. October's weekly levels are in the 115,000 to 125,000 range, all plants and types included. Why so close to September rates? One reason: Changeovers are due this quarter; they'll lop full days off schedules; so volume can meanwhile go on unimpeded.

The changeovers will bring forth 1952 lines which in some cases are much revamped, in others are barely face-lifted. Major changes: a new powerplant for DeSoto (and one not long after for Dodge).

A new 6-cyl powerplant for Ford and Mercury.

Power steering for Cadillac, maybe big Olds and Buick models, too, and for Packard as well.

A treadle brake, power boosted, hinged at top, for Olds.

New fender treatments, a la Cadillac, for Ford.

A brand-new Lincoln, body and engine alike.

• • •

Even after these new things come along, more will follow, some voluntary, some involuntary. To get an idea of the latter, take a look at a list prepared by Reynolds Aluminum, showing shifts anticipated from steel and iron.

"Imminent," says Reynolds, are shifts to aluminum on water pump, grillwork, carburetor and fuel pump, steering gear housing, wiring, battery to starter cable, striker plate (at the rear of the front seat), gas tank and fuel lines, and the inner deck lid.

"Probable" turns to aluminum are seen by Reynolds on fan assembly, radiator, bumper and bumper guards, main bearing caps, transmission and differential housings, connecting rods, and brake shoes.

• • •

Detroit companies, beset by delays and slowness in machine-tool deliveries, feel the full military program may not reach peak when it was expected to — midway through 1952. Their view now: Biggest bulge in arms output will not come until the end of 1952, conceivably even the start of 1953.

• • •

September car sales were disappointing in Wayne County (Detroit), often looked on as a bellwether. Volume dropped to 11,090 deliveries last month, compared with 19,196 in September 1950; largest proportionate loss was in the lower priced vehicles.

The Wayne sales were down about 10% from the August showing. Nationally, August reflected the first month-to-month upturn since May.

• • •

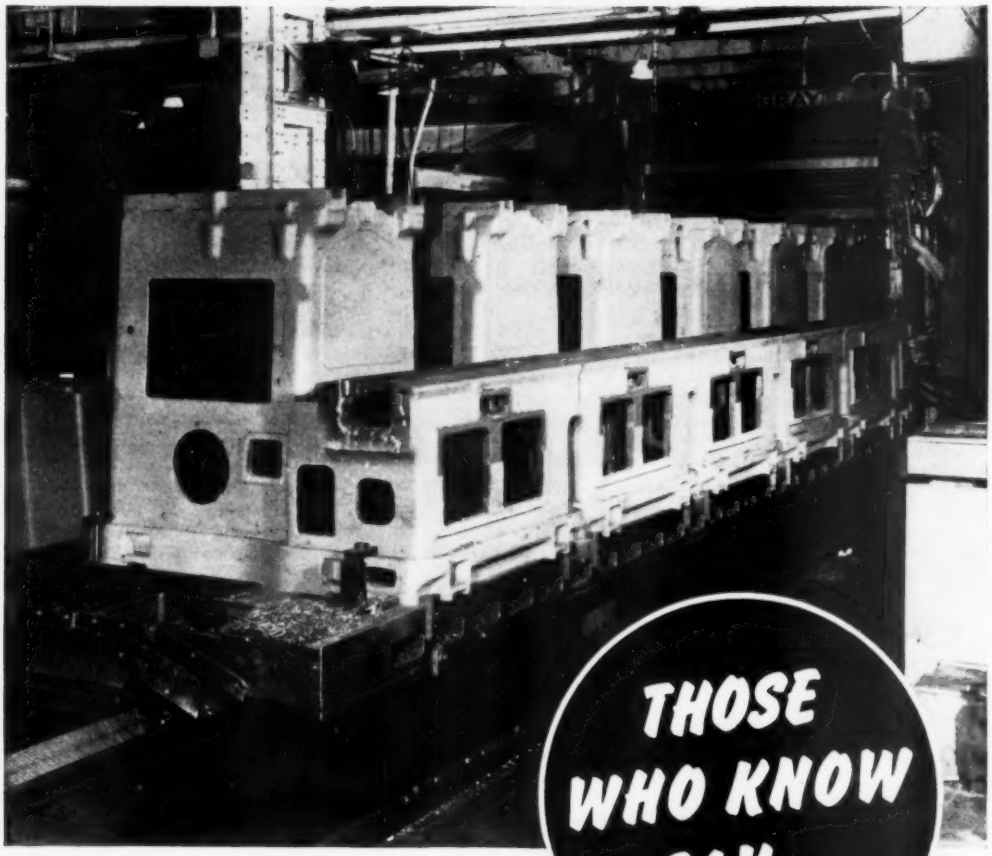
Approximately 15% of the $50-million modernization program at the Ford Motor Co.'s Rouge plant has been completed.

The program will eventually increase capacity of the plant by approximately 190,000 tons of finished steel annually. Most of the work in the program will be completed by end of 1952.

Already finished are alterations to the 66-in. tandem cold reduction mill and alterations on the entry to the 84-in. temper mill. Well along is the installation of 16 new annealing furnaces and 41 bases in the cold mill.

• • •

Nash is now marketing a Rambler Deliveryman, a commercial utility vehicle. It looks like the Rambler stationwagon, has an all-steel platform more than six ft long with tail-gate down, and offers more than 52 cu ft of cargo space with gate closed.



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Machine Tools

Pool contracts offered to machine tool builders by Washington are not far from the $1-billion mark. At last count, they totaled over $830 million, and at least another $100 million is to go out shortly.

Some 97 companies and 55,000 machine tools are included in the total to date.

• • •

Fifty-eight builders have accepted pool orders for 23,000 machines valued at $330 million.

Three big pool contracts are being negotiated: one for $49 million, a second for $59 million, and a third for $69 million.

These contracts, as well as other sizable ones, are slow in closing because of certain factors, such as ability to get materials and subcontractors.

One pending pool contract requires 16 subcontractors, if the job is to be done on time.

• • •

Only seven orders have been rejected, involving 3000 machines and $44 million. Some of these orders may yet be accepted as terms and conditions are changed to make them more satisfactory.

A mere handful of builders has sought the 30% cash advance from General Services Administration. The vast majority have made their own financial arrangements on better terms than GSA's 4% interest charge.

GSA is far from inflexible on delivery dates on pool orders. Some contracts specify delivery far into 1953, but most are for 1952.

• • •

Completely reversing its former policy, GSA is putting out pool orders to the limit of its financial ability. It is covering only 30%, against its insistence upon 100% previously.

Fresh pool orders are likely to come out for some time ahead. GSA can get more money if it badly needs it and a certain amount of funds is being released for fresh pool orders as deliveries are made from week to week under existing pool orders.

GSA officials are reported leaning over backward to help builders meet terms laid down for acceptance of pool contracts.

• • •

The French are out to get from U. S. builders 200 to 300 machine tools needed to start their armament program.

General Eisenhower has asked Secretary of Defense Lovett to help expedite this request.

French have ordered about 900 machines here, totaling over $16 million. But they dilly-dallied in making decisions and did not place orders until long after the British.

• • •

Washington will do nothing about this French request until the NATO countries get together in Paris and agree upon what European tooling programs are of greatest importance.

What program should come first and in what country? What one is second? Eisenhower presumably will have something to say on this point.

A. J. M. Baker, of the U. S. Economic Mission in London, will sit in at the Paris pow-wow.

As soon as the priority preference is determined, representatives of NATO will come to Washington to press for deliveries of U. S. machines vital to the European programs tagged with a super-priority. That is likely to be by mid-November.

• • •

These representatives may put forth this proposal: That certain European tooling programs are just as essential to U. S. defense as some of our own tooling programs here. Hence it may be desirable to push back to a later date the delivery of machines on domestic programs in order to speed Europe's rearmament.

Such action would involve reexamination of builders' order boards, in the 70% category as well as in the 30%.

This could not be done without the consent and cooperation of Pentagon.

• • •

British are reported to have placed substantial orders for T-lathes in Germany. Alfred Herbert also is to build T-lathes.

British demand for T-lathes in this country will be correspondingly decreased.

Vermont Marble Co., Rutland, Vt., shipped on Oct. 24 its first 60-inch universal Lodge & Shipley T-lathe. It has a major subcontract with Lodge & Shipley for complete machines. Lodge & Shipley also has arranged for Nordberg Mfg. Co. to make T-lathes at Milwaukee and at its Busch-Sulzer Division at St. Louis.

• • •

Activities looking toward importation of foreign machine tools into U. S. are continuing.

Machinery Builders, Inc., New York City, is said to have closed a deal for bringing 10 German lathes a month into this country.

One prominent German builder is quoted as saying that he is not interested in selling his machines here. His future market is in Europe and other parts of the world and not in the United States, where he will be squeezed out by competition and by tariffs (if they are necessary).

• • •

What NPA would like to know is: What jet engine tooling program should take precedence over another? Up to now, all jet tooling programs have been of equal importance. Only sensible thing is to pick out the most critical one and get it going. Then take the next most critical program.

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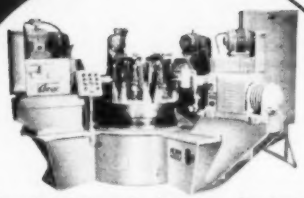

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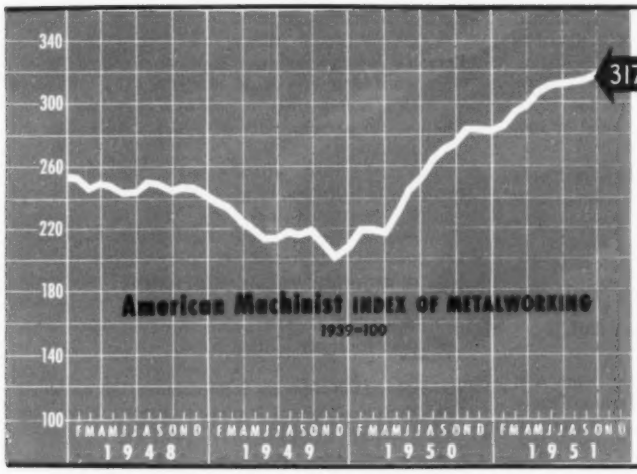
WRITE FOR ENGINEERING CATALOG NUMBER 51

Gaging Metalworking



INDEX

BASED ON MANHOURS WORKED IN THE FIVE COMPONENTS

	OCT '51	SEPT '51(p)	AUG '51(r)	SEPT '50
	317*	314	312	279
Machinery	302	304		249
Electrical Manufacturing	342	351		323
Automobiles, Trucks	227	226		258
Transportation Equipment	463	454		288
Other Metalworking	305	313		307

* Estimated (p) Preliminary (r) Revised

Metalworking Leads Industrial Output

Metalworking is leading the slow upsurge in industrial production. This is not surprising, in view of the fact that the metalworking industries produce guns and tanks and planes.

American Machinist index is estimated at 317 in October (1939 = 100). This is on basis of manhours worked. That is up three points from September, which in turn was two points higher than August.

Just how far Metalworking has gone since September, 1950 is shown by the index. The figure that month was 279, against today's 317.

• • •

Nothing has happened to change the earlier forecast that the index is likely to move up steadily to around 350 by the middle of next year.

The pinch on CMP materials is expected to be the worst then, and to last the remainder of '52.

Washington appears to bet even money that the Korean conflict will come to a halt before winter. But even if that happy event should come off, the defense program seems destined to stay in high gear.

• • •

Metalworking companies on West Coast fear serious dislocations in production next quarter if allocations of materials are as low as expected.

Though defense work is growing, it isn't coming in fast enough to take up the slack if civilan goods are cut back sharply.

Stockpiles have kept operations up on civilian goods, but the bottom of the pile is not far off. Airframe makers have not yet run into production slowdowns caused by materials shortages. But they see that day coming before midsummer of '52.

• • •

Aluminum is major headache on Pacific Coast, with copper a close second. Steel is not yet a pressing problem with most companies.

But some complaints are heard that western steel mills cannot fill needs on the coast because of required shipments east.

Defense production in San Francisco area will be mainly in facilities specially built or remodeled for armament work.

Prospective expansion in West Coast shipbuilding is hard hit by sudden suspension of work as result of steel pinch.

• • •

Defense work is picking up slowly. Ordnance contract awards will reach a peak in December, with over $14 billion being obligated this fiscal year.

But production will not reflect defense business in a big way until a year from now.

One large auto maker will not get going on armament until mid-1952. Another has 20% of its current operations on defense items, expects the ratio to increase to 24% by second quarter of '52.

Detroit's situation is not much different from other parts of the country and from other industries.

• • •

Schedule for military planes is being pared to fit output of engines, which is below expectations. AF and Navy will get 5000 planes this year.

Gaging Business

Industrial outlook up to mid-1952 is rosy. Industrial production, currently at about 223, is likely to rise to 230-235 (1935-1939 = 100).

Durable goods will represent practically all the gain. But non-durables will do well too. They will stay at or near their present level of 200.

• • •

Capital expenditures continue amazingly high. Third quarter hit a new peak in manufacturing outlay for new plant and equipment. Only materials shortages kept it from being bigger.

Total outlay for all business will come close to $25 billion this year, according to Securities and Exchange Commission and Dept. of Commerce. Manufacturing's share will be over half.

• • •

It doesn't look like the capital spending boom will peter out soon. Witness plans of General Electric and Westinghouse to spend $750 million between them in next few years. Other companies have similarly ambitious plans.

More certificates of necessity, for fast write-offs, have been issued in past 60 days than at any time since the start. This was in a "moratorium" period, mind you.

Total of 1483 certificates (around 35% of all issued so far) was granted. In all, 4119 projects, calling for expenditures topping $10 billion, have been given Washington's blessing.

• • •

Much of the anticipated inflationary pressure on prices has not developed. It's not likely to become critical in weeks right ahead.

Though prices may go up at both retail and wholesale levels, they will move slowly.

October appears sure to see first increase in wholesale prices in seven months. Prices have risen fractionally for last five consecutive weeks.

Cost-of-living index probably was up in September.

• • •

Personal income shows no signs of stopping its upward course. August rate was $254 billion, or 12% higher than in August a year ago.

The gain in personal income was $27 billion in one year.

• • •

Business inventories, in general, declined in August for first time since July, 1950. But stocks in manufacturers' hands continued to expand.

It's possible that retail inventories of some consumers durables (appliances, autos) may shrink to a state of actual shortage by early next year. But no one seems worried much about that prospect at this point.

• • •

Unemployment went up in September, but not much. Reason: students leaving summer jobs and returning to school.

Defense still isn't taking the quantities of metals that it should under plans for military expansion. Thus some civilian durable-goods makers will be turning out more units in early 1952 than forecast.

• • •

Manufacturers' shipments and new orders gained more than seasonally in August and September.

They returned to the June level. The increase was sharpest among durable-goods producers. Motor vehicles and machinery made the best showing.

NPA has cut metal allotments for first quarter to freight car builders. Only about 7000 units per month will be built, against 9000 at present. Labor difficulties kept freight car assemblies down this year below 10,000 units, for which metal was at hand.

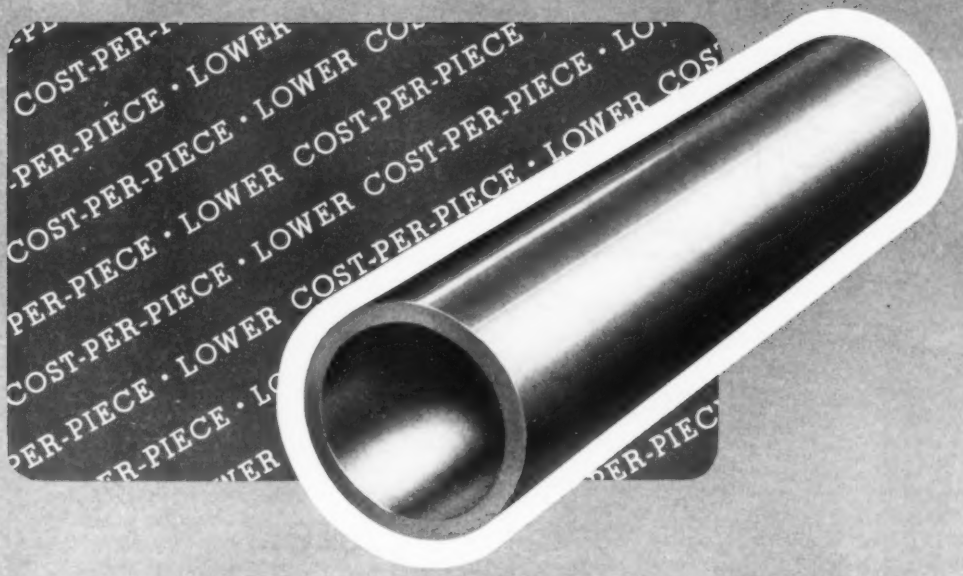
WEEKLY BUSINESS INDICATORS

	Latest Week	Preceding Week	Year Ago
Business Week Index of Activity (1923-1925 = 100)*	231.9	231.9	223.0
Steel ingot production (thousands of tons)	2,041	2,035	1,967
Electric power output (million kilowatt hours)	7,160	7,156	6,509
Production of automobiles and trucks	121,351	112,868	174,234
Engineering construction awards (*Engineering News Record*, millions)	$195.2	$241.9	$260.8

QUARTERLY BUSINESS INDICATORS

	Latest Quarter	Preceding Quarter	Year Ago
Gross National Product (billions)	$328.0	$325.6	$287.4
Expenditures of new plant and equipment (millions)	$26,440.0	$27,200.0	$23,330.0
Profits after taxes, in primary iron and steel industry (millions)	$265	$253	$281
Profits after taxes, in machinery industry (millions)	$297	$291	$265
Profits after taxes, in electrical machinery industry (millions)	$126	$164	$144
Profits after taxes, in motor vehicles and parts industry (millions)	$276	$265	$490
Motors and generators new orders index (1936 = 100)	696	780	337

* Seasonally adjusted.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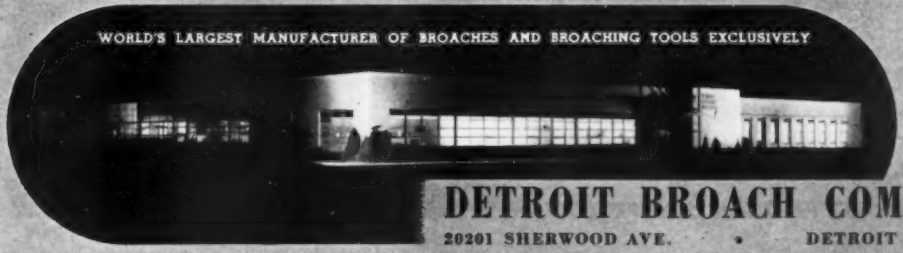
Review of present broaching operations by qualified specialists can usually increase broaching efficiency. An example is the broaching set-up for the 1½" inside diameter of the 8" long, soft steel tube above. Here is what happened when Detroit Broach engineers studied the broaching set-up.

By changing the tool design, the number of sharpenings per tool was increased 26%. Change of steel and heat treat, as well as improved manufacture of the tool, upped the number of pieces produced per grind 46%. Thus, even though original cost was increased $18.00 per tool, cost-per-piece was reduced 50% . . . *a net saving of $880.00 per month!* In addition, reject rate for the operation was cut from 11% to 3% due to the substantial improvement in surface finish on the parts.

This is a typical example of how Detroit Broach specialization pays off . . . in ingenuity that comes only with singular familiarity with all phases and types of broaching. Whether yours is a new broaching application or raised sights on a present one . . . consult Detroit Broach for actual cost and production data.



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Front cylinder cover for popular automobile engine.

FIRST CYCLE

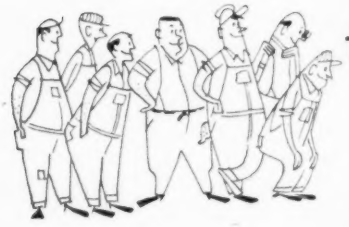
Station 1: Load on piece
Station 2: Horizontal Head—
Drill 3 holes 5/16" diameter
Drill 8 holes 13/32" diameter
Bore 1.80" diameter
Station 3: Horizontal Head—
Drill 4 holes 13/32" diameter
Chamfer 3 holes for 3/8—16 tap
Drill one hole for .1563 diameter ream
Station 4: Horizontal Lead Screw Tap Head—
Tap 3 holes 3/8—16
Ream one hole .1563"

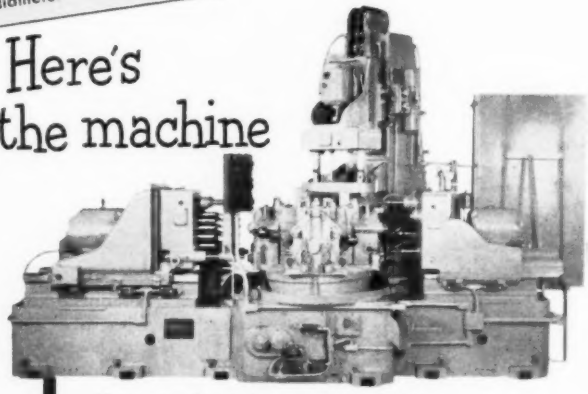
SECOND CYCLE

Station 1: Transfer and load
Station 2: Horizontal Head—
Drill 3 holes .257 diameter for 5/16—18 tap
Station 3: Horizontal Head—
Chamfer 3 holes for 5/16—18 tap
Vertical Head—
Rough bore and chamfer 2.558" diameter
Section 4: Horizontal Lead Screw Tap Head—
Tap 3 holes 5/16—18 tap
Vertical Head—
Finish bore 2.558" diameter

Here... the cycles

Here's the machine





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American Machinist

MAGAZINE OF METALWORKING PRODUCTION ★ ESTABLISHED 1877

What Dual-Purpose Plants Will Do

Our nation is committed to support two economies at once. One is a national defense economy—an outpouring from our factories of weapons of defense. The other is a civilian economy—an outpouring from our factories of peacetime products.

Washington hopes, before long, to have both these economies operating side by side. It is not to be a short-term operation. It is to last far into the future.

Never again are we to be "unready" in case an enemy should attempt a new Pearl Harbor.

THAT MEANS that never again is American industry to be "unready." For, as President Charles E. Wilson of General Motors has stated, "It is essential that we recognize that the time it takes to go to war is no longer the time it takes to train a soldier, but rather the time it takes to produce his equipment and arms."

Up to now, the rush to produce in an emergency has been after the war alarm was sounded. It has been exorbitant in cost, disruptive to the civilian economy, and in the earlier stages "too little and too late."

If we are to live in an arsenal economy from now on, we should plan adequately and intelligently for it. On that point, Mr. Wilson, speaking at the annual meeting of the American Ordnance Association in Cincinnati, had an inspired thought.

SUPPOSE we set up dual-purpose plants to be run by companies which will be prime contractors to the armed services. Mr. Wilson stressed that such plants could operate in any of three ways: produce defense goods, produce civilian goods, or produce both defense and civilian goods.

One factory under one roof, for example, could build both jet engines and automobile body stampings. Mr. Wilson illustrated with drawings the practical application of this plan.

Mr. Wilson's plan would get away from the terrific cost and the months of agonizing delay of erecting special war plants in an emergency. It would remove the need for building tens of thousands of new machine tools within a matter of months to tool up these plants. It would eliminate the necessity for making, as a protective measure in peacetime, thousands of tanks and guns and planes which would be obsolete in design almost before they came out the factory doors.

Instead, we would have dual-purpose plants ready to switch on short notice from one type of product to another. The managements, supervisory forces and workers would be familiar with the techniques of making both defense and civilian products.

HERE, for the first time, is a sensible program for keeping our productive facilities flexible and able to swing swiftly onto a full war basis, or a full peacetime basis, or something in between.

It would be less disturbing to the national economy than the violent fluctuations experienced in World War II and in the present crisis. It deserves solid support by industry and by our government.

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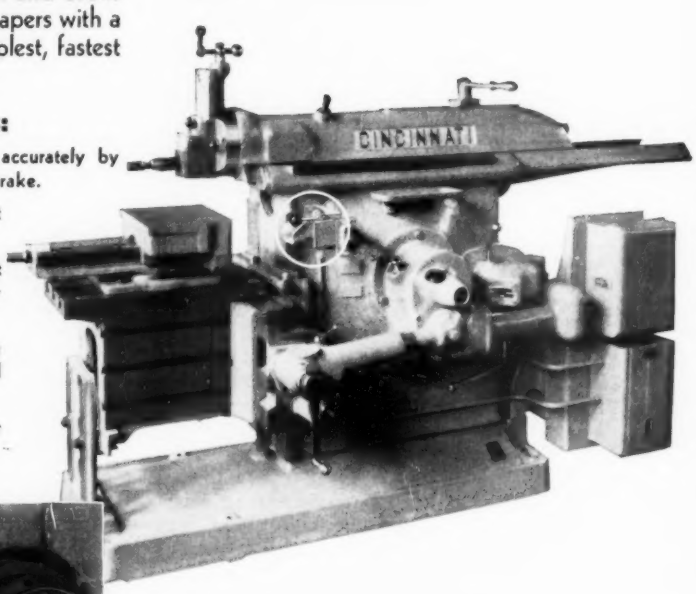

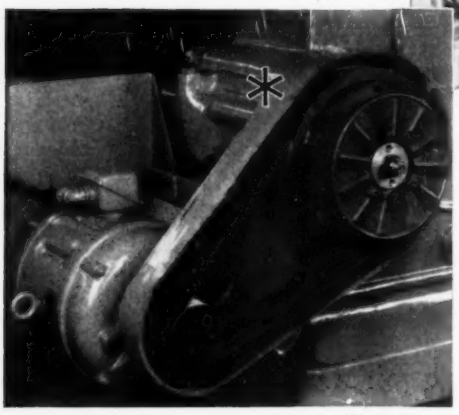

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SHAPERS · SHEARS · BRAKES

US tanks in action in Korea have performed with merit under a wide variety of operating conditions. Over-all effectiveness of tanks will be further increased over present standards through action of new range finder recently developed at Frankford Arsenal. Techniques employed in the manufacture of this instrument are among the latest developed for fire-control instruments

Industry's Latest Big Job:

American Machinist ARMAMENT REPORT

BUILDING THE NEW TANK RANGE FINDER

BY MILES J. ROWAN, ASSOCIATE EDITOR

From interviews at the Fire Control Instrument Group, Frankford Arsenal, with

COLONEL ALAN A. GEE, Chief — Ground Weapons Dept.
J. M. THRESS, Chief — Engineering Div.
C. T. DEAL, Project Engineer
DONALD BROWN, Ordnance Engineer
WILLIAM SPERLING, Ordnance Engineer

Latest practices in the manufacture of fire-control instruments are incorporated in the new range finder . . . Described here are three of the post-war techniques developed at Frankford Arsenal and now being applied in other plants producing fire-control equipment

LARGEST single optical-instrument job yet initiated by Army Ordnance is the program now under way for building a new range finder. Scheduled for installation in the medium tank, the new range finder is the most effective system yet conceived for tank fire control. With this instrument, the effective range of first-round hit probability is double that of any tank currently in action.

Actually, the new device is far more than a range finder. Designed and developed in the Fire Control Division of Frankford Arsenal, it is a stereoscopic type of instrument that performs the three major functions required for accurate fire at fixed or moving targets. These functions are: ranging, sighting, and computation of ballistic super-elevation. Prior to development of the new equipment, it has been necessary to estimate range.

While the new range finder is a big step forward in fire-control instruments, it also represents a production job that, at present, exceeds available capacity among the manufacturers of optical instruments. To fill the gap, six companies outside the instrument field have accepted prime contracts to build the device. Numerous sub-contractors also are participating. Although it is expected that much of the machining work can be performed by conventional tooling methods employed for precision work, production of the range finder also involves several techniques with which industry in general has had little or no experience. For example, optical glass in the instrument is bonded directly to metal mounts without mechanical fasteners. Secondly, the entire instrument must be hermetically sealed against the atmosphere. A third process, seldom required except for computing mechanisms, is the production of accurate non-circular gears.

While these techniques are relatively new to in-

"When the fighting man first put down his club and picked up a rock, he also picked up a problem—that of controlling his fire so his missile would hit the target. With the evolution of mechanical weapons of greater power and complexity, came a resultant increase in the complexity of the fire-control problem. Assisting industry to provide the equipment necessary to solve this problem is the mission of the Fire Control Instrument Group."—Visitor's Guide, Frankford Arsenal

dustry, they have been under investigation at the Fire Control Instrument Group for several years and much valuable information is available as a guide to industry in setting up methods of performing these operations on a production basis. Described in this article are the methods currently employed at the Fire Control Instrument Group for glass-to-metal bonding, cutting non-circular gears, and injection sealing—techniques that are employed on the new range finder and that will find increasing application on all fire control instruments.

Glass-to-Metal Bonding

DEVELOPED in the Fire Control Laboratory only during the past three years, the technique of bonding a precision optical element directly to its metal support is one of the latest advances in the manufacture of fire-control instruments. Adhesives are employed to accomplish the bond and no clips, screws, or other mechanical fastening devices are required. The result is an extremely simple construction that withstands severe shock better than any other method yet devised. As this feature is of primary importance in any instrument designed for tank installation, it would of itself justify selection of adhesive bonding for the new range finder. However, the bonding method has the further advantage of permitting designs that give the high accuracy required in fire-control optics at a lower cost than is possible with conventional fastening methods.

For example, one of the features in the new range finder is the penta reflector. This unit, which is a radical departure from conventional designs, consists of three pieces of optical glass cemented together and bonded to a single steel support. These are positioned and cemented in a fixture that locates two separate reflecting surfaces within one minute of arc. The assembly then is bonded to its metal base. This eliminates the need for the final adjusting and hand-polishing operations that are required with conventional designs employing solid penta prisms and mechanical fasteners. At the same time, light-beam reflection is extremely accurate over a wide range of temperatures. This is possible because of the high stability of the particular cement used, and because of the relatively thin cross-sections of the reflectors and crossbar which avoids temperature gradients during heating and cooling of the instrument. The glass sub-assembly is safeguarded somewhat from shock by the cushioning effect of the bond between the crossbar and the metal mount. While these features are mentioned in connection with the penta reflector, they are generally true of adhesive bonds as they are made in the Fire Control Instrument Group. In the new range finder, all prisms are mounted in this way.

How Bonding Is Done

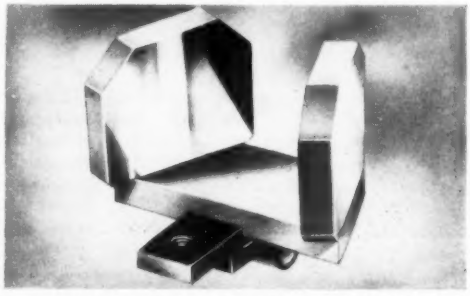
The technique of bonding was developed in the Laboratory with the cooperation of Narmco, Inc., San Diego, manufacturer of the two adhesives employed in the process. Basically, the technique requires thorough cleaning of the parts to be bonded, application of the adhesives, positioning of the parts in bonding fixtures, and baking to cure the bond.

As, at present, there is no satisfactory way to separate a bonded joint, all components should be thoroughly checked before bonding. Surface finish on machined pads to which the glass is bonded should be no less than 125 mu in. rms, and all rust, grease, or other contaminants must be removed. Vapor degreasing has been effective at the Arsenal and undoubtedly other commercial solvents will clean satisfactorily. Ground surfaces of optical glass can be cleaned by "scouring" and rinsing in the normal way. A final rinse with ethyl alcohol will insure preparation of either metal or glass surfaces.

Adhesives are applied in thin coats, with a short drying period between coats, until a layer of correct thickness is obtained. Either a brush or spray gun can be used depending upon the area to be covered and the masking required. Parts then are airdried and baked to evaporate solvents.

Employs Two Adhesives

Actually coatings include two different adhesives. One has high strength but does not flow readily. The second does flow and is applied last to provide a high degree of contact area for bonding. It over-



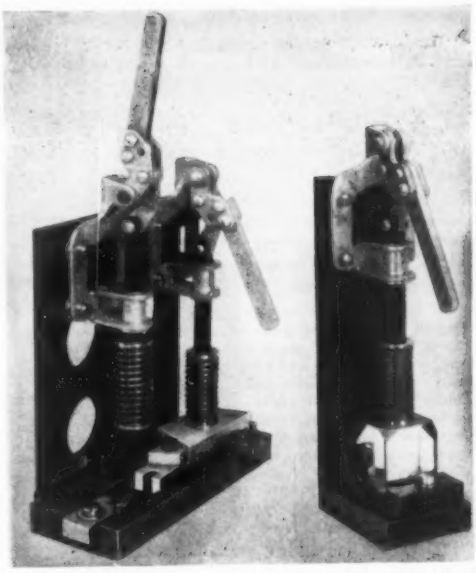
Penta reflector consists of three pieces of precision optical glass cemented together and attached to steel mount by new technique for bonding optical glass to metal. No mechanical fasteners are needed

comes irregularities in the initial layer and increases the continuity of the bond. The first adhesive, however, after airing provides the elasticity that enables the bond to withstand reasonable shock and the effects of temperature change. In tests conducted regularly at the Fire Control Division, bonds are subjected to a temperature of –80 F without damage either to the bond or to the optical glass.

Curing of the bond is accomplished by oven-baking at 270 F for 2½ hr. Oven control settings must be established for each bonding operation to make sure that the entire assembly and the whole batch are held at the correct temperature for the specified time.

After curing, the assembly must be brought back to room temperature gradually so strains will not be introduced. Finished work can be inspected visually. A continuous bead of cured adhesive indicates that sufficient adhesive has been applied. Voids should not exceed 10% of the bonded area.

While this process has worked successfully on the jobs for which it has been selected thus far in the Fire Control Instrument Group, considerable experimentation had preceded each application. Potential users should study each application carefully before adopting the technique for their production.



Bonding fixtures insure mechanical alignment of glass and metal parts during curing of bond in oven. Spring maintains constant bonding pressure during heat cycle. Fixture at left is for simultaneous bonding of two penta-reflector crossbars to their metal bases. Second fixture is for bonding the transfer prism of the range-finder collimator to its metal base

Non-Circular Gearing

One of the most significant developments in the production of highly-accurate non-circular gears is a machine constructed approximately three years ago in the Fire Control Laboratory. Invented by Dr. John G. Tappert and William Sperling, Frankford Arsenal, this machine greatly reduced the time required to produce one pair of gears and also makes possible the quantity production of gears of much greater accuracy than formerly was possible.

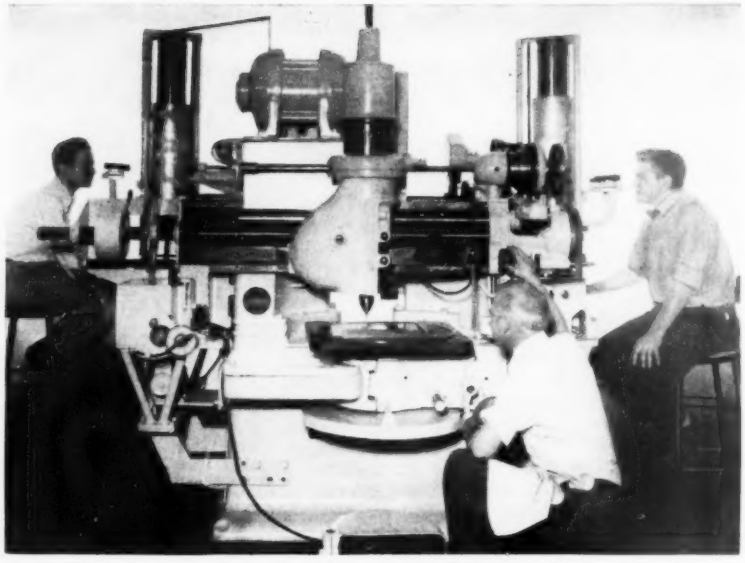
While non-circular gears have had only limited application in industrial machines, they are used extensively as computing elements in a number of fire-control applications. Durings World War II, however, non-circular gears were not produced in large numbers. As a result of the production problem of that period, a machine for producing non-circular gears from a master set was built for Frankford Arsenal by a commercial machine-tool builder. While this machine was entirely satisfactory and, in fact, is the method used in the industry today for producing non-circular gears in quantity, the masters were produced by a method of approximation, and errors in the master set were reproduced in all gears cut from them. Furthermore, production of the masters was extremely slow and costly.

Essentially, the method consisted of approximating the pitch curve of the gears by a series of tangent circular segments. Gears then were cut on a standard gear shaper provided with special fixtures and accessories. Each circular arc in turn was set up and cut about its center. As a tremendous amount of work was required not only to compute and set up the center and the radius of each circle correctly, but also to qualify the position of every tooth along the pitch line, an average of one month was required for computation and two weeks for production of one gear. To eliminate this bottleneck, the Fire Control Instrument Group constructed the machine designed by Tappert and Sperling.

How The Machine Works

This machine is a modification of a standard Fellows type 6 gear shaper and generates non-circular gears by cutting them about their own centers of rotation. No approximations are involved and the working surfaces are generated continuously. Small lots can be produced quickly and economically by manual operation but the machine also can be set up for completely automatic operation for comparatively high production. Gears up to 16-in. dia can be cut and held to accuracies of 0.001 in. on all dimensions.

Basically, the machine accomplishes the two major functions that are necessary to cut non-circular gears: it permits the center-to-center distance between the work and the cutter to be changed constantly and it also provides a continuously variable speed ratio between the cutter and the work to qualify the position of teeth along the pitch line. These motions are controlled by computing mechanisms similar to those required for the fire-control equipment. For automatic operation, the mechanisms must be designed and built to provide the



Special gear cutter produces non-circular gears that are accurate within 0.001 in. on all dimensions. Operators at each drum control machine movements by keeping cross-hairs of telescope on curve representing functional relationship of gears. Machine reduces time to produce one gear from weeks to hours

functions required for generating each particular type of gear.

For manual operation, universal mechanisms that can be modified for cutting gears of any shape are provided. Required functions are plotted on graph paper and attached to drums that rotate slowly through change gears. One drum is for table rotation, the other for center-to-center distance between the cutter and the work. One operator at each drum then operates the machine controls to keep the cross-hairs of a collimating telescope directly on the function drum. This controls the machine movements to produce a gear of the desired shape.

In the new range finder, Arsenal engineers selected non-circular gearing to handle those phases of the computation for range and for super-elevation in which it is necessary to convert from linear to non-linear functions. Production of these gears will pose no major problem, however, as masters of the required accuracy now can be produced readily on the Arsenal machine. These then can be supplied to industry for duplication in whatever production quantities are needed.

Injection Sealing

EXPERIMENTS in injection sealing began at the Fire Control Instrument Group in 1946. At this time field tests revealed that gasket-sealing of optical instruments failed to provide adequate protection under all climatic conditions. Tests indicated that instrument failures were prevalent when temperature changes increased the relative humidity within the instrument and caused fogging of the lenses. To overcome these failures, injection-sealing techniques were developed.

On the new range finder all sealing will be done by the injection method. This consists of completely filling a formed cavity between two mating parts with a viscous material that is forced into the cavity under pressure. The material employed depends upon whether the seal is static, or rotary and/or translatory, and whether bonding as well as sealing is required.

Static seals, which are those on stationary parts, generally are made with a synthetic rubber-base compound approximately 100% solids by weight. This compound has excellent adhesion to metals,

Non-circular gears are employed in computing mechanism of range finder. Input to driver represents independent variable at given scale factor while output of driven gear represents required non-linear function

glass, and most materials, but adhesion does not develop until one or two hours after contact. It absorbs shock and remains pliable even at extremes of temperature. It has no bonding properties and fasteners must be employed to hold the parts.

For both sealing and bonding a curing-type compound has been developed. This compound requires baking at 165 F for 4 to 8 hr, baking to begin within two hours after injection of the material. Fixtures are required to locate the parts accurately during assembly and to provide even distribution of the space in which the compound is inserted. However, fasteners can be eliminated and, on the range finder, this compound is employed to position and lock lens holders which are exposed to the atmosphere.

Experience thus far has shown that static seals are entirely satisfactory. For example, in one test conducted at the Fire Control Laboratory, an injection-sealed instrument was placed in a pressure cooker for a period of several hours. Despite the extremes of temperature, humidity, and pressure, no damage occurred within the instrument.

Production testing, of course, is non-destructive. While there are several ways in which testing can be performed, the method currently in use is to place the sealed instrument in a chamber under pressure. A drop in pressure indicates a leaky seal. When the instrument is placed under water, bubbles reveal the position of the leaks and the pressure that has built up within the instrument prevents the entry of the water.

Rotary and translatory seals are those around shafts having either type of motion, or perhaps both. These seals present somewhat of a problem, as manufacturing tolerances must be held within close limits to prevent loss of the sealing compound around the joint. At present, the best compound is a mixture of a synthetic rubber compound and a di-ester grease. However, work is continuing to find another compound that will operate satisfactorily under wider limits than those now possible.

Sealing Equipment and Methods

Injection sealing can be done with hand, portable, or fixed equipment. The main requirement is a gun that will develop sufficient pressure to insure complete filling of the cavity. However, experience in the Fire Control Instrument Group has shown that certain features are desirable and these are incorporated in equipment now in use.

Features of Injection Guns

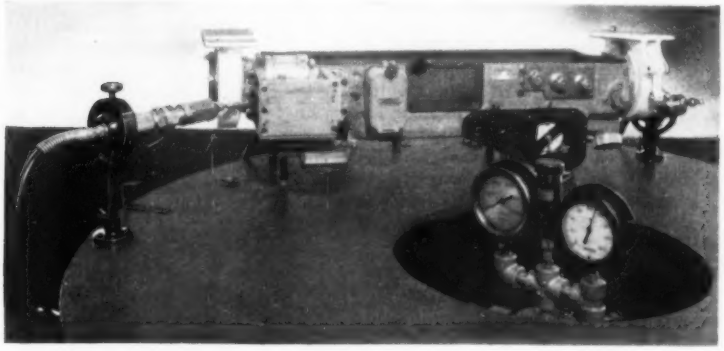
One of the setups developed in the Group, for example, is a six-gun workstation operated at pressures ranging up to 3000 psi from a central air supply. Guns are of the piston type and have threaded tips. These engage tapped holes in the work and provide a positive means of holding the gun to the work. Each gun is held in a universal mount that provides ready adjustment in any direction. This permits alignment of gun and work and reduces the danger of broken nozzles. To provide the same features in hand guns, flexible connections or swivel tips can be installed at the nozzle of the gun.

Compound is packaged locally in containers that fit the injection guns. This is a convenient way of handling the material and simplifies the task of cleaning the gun when changing from one compound to another.

Injection Process

During injection, compound flows through the connecting hole into the cavity. Steady pressure is maintained until the compound forces out the next hole. Normally for long cavities several holes are provided and injection is performed progressively. Injection in each section should be continuous, however, to avoid formation of air pockets. If injection holes are larger than ⅛-in. diameter they must be plugged with a screw to prevent the compound from working out. Care should be taken to avoid all burrs or obstructions in the cavity and surfaces must be clean for good adhesion.

The actual pressure required for sealing depends upon the viscosity of the compound, the length and contour of the cavity, the cross-sectional area of the cavity and the injection holes, and the surface smoothness of the cavity. Proper design of cavities and injection openings, therefore, will do much to avoid trouble in production.



Injection-sealing work station has six guns operated at pressures ranging up to 3,000 psi from central air supply. Gun is forcing compound into sealing cavities of the ballistic cam housing on the new range finder. Gun has threaded tip that fits tapped hole in piece and holds both together during sealing. Universal mount permits adjustment in any direction to insure alignment of gun and work

METALLURGICAL CONSIDERATIONS IN MACHINING ... IV

TOOL WEAR RESULTS FROM SEVERAL

Wear on the clearance face is the combined effect of pressure welds, temperature welds, and the lapping action of hard particles in the work material. Degree of wear from the first two is a function of cutting speed. Furthermore, at some speeds, wear is accelerated as the tool matrix loses hardness relative to the workpiece matrix

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WHEN a cutting tool has been in use for some time, wear may become evident in two regions. Wear usually appears first on the clearance face, but may also be found on the tool face along which the chip slides. Tool-face wear, or cratering, does not extend to the cutting edge, but begins some distance from the edge. Clearance-face wear does extend to the cutting point. The wear area here is often referred to as the wear land, distance *AC*, Fig. 1.

Wear land is usually visible before a crater, because inclination of the clearance face gives rise to a magnification of the lateral wear *AB*. For a 5° clearance angle this amounts to magnification by the cotangent of 5°, or 11.4.

In tool-life studies on cemented carbides, it is customary to report either the cubic inches of metal removed or the cutting time required to produce a wear land of 0.030 in. Life of a HSS tool is expressed as the cubic inches removed or the cutting time for complete destruction of the cutting edge.

Life of a given cutting tool will vary with the cutting speed and feed, the chemical composition of the metal cut, and its metallographic structure. Let us first consider variation in tool life with speed and feed, when work characteristics are maintained constant.

Several methods have been used to designate tool life. In 1894, F. W. Taylor introduced a "twenty-minute tool life," which was the cutting speed required to give a tool life of 20 min. This method does not present a picture of how tool life varies with cutting speed. Subsequently, it became common practice to represent tool life in the form of a curve in which the logarithm of the cutting speed (sfpm) is plotted against the logarithm of the tool life in minutes. Accelerated tool life curves plotted in this way are linear and can be represented by the equation:

$$VT^A = B \qquad (1)$$

where V is the cutting speed, sfpm; T is the tool life, min, and A and B are constants. For a HSS tool cutting steel, the value of A is about 0.1, and B is 150. For a cemented carbide tool, $A = 0.125$ and $B = 600$.

While the tool life in minutes may have merit in computing machining costs, it is not a good way of measuring life in tool-wear studies. Tool wear is related to the total chip area that passes across the tool face. Hence, it is more advantageous to express tool life in terms of the volume of metal removed, because this quantity is proportional to the chip area for a given feed rate and depth of cut. Equation (1) may be rewritten in terms of a tool life L, expressed in cubic inches of metal cut rather than time T:

$$VT^A = B = V(VtbT)^A (Vtb)^{-A} \qquad (2)$$

or

$$LV^{\frac{1-A}{A}} = (tb)B^{1/A} = B^1 \qquad (3)$$

where t is the feed rate, ipr
b is the depth of cut, in.
$L = VtbT$, tool life in cu in.
B is a constant.

The data of Fig. 2*a* are shown plotted in Fig. 2*b* in accordance with equation (3). This is still not the best method of presenting such data. Log-log coordinates tend to obscure important aspects of the tool-life curve. It is preferable to use rectangular coordinates as shown in Fig. 2c. Here, it is evident that the tool life decreases very rapidly above a certain speed: about 100 sfpm for HSS and 400 sfpm for carbide.

Valley of Death

Tool life does not always approach zero monotonically as shown in Fig. 2c. Under certain conditions, tool-life curves such as that shown in Fig. 3 are obtained. This is the sort of curve that has been obtained with a carbide tool when machining a material such as SAE 1112 steel. While the hills and valleys shown here are not always observed, their presence in this instance shows that tool wear cannot be explained in terms of a single mechanism. Instead, there are several causes for wear that assume different degrees of *relative* importance as cutting conditions change.

In general, all tool wear may be attributed to two basic causes:

1. The plowing or gouging action of the carbides and other hard constituents in the matrix of the metal cut.

2. Wear that results from instantaneous welds formed when

CAUSES

the finished surface (or chip) slides across a tool face.

The plowing action of the hard particles embedded in the relatively soft workpiece matrix is akin to lapping. The rate at which material will be removed by this means depends upon the size and number of hard particles per unit area, and the relative hardness of the tool and work matrices. Also, relative hardness of the two matrices may be altered during cutting as a result of strain hardening.

When metal is cut, the chip is forced against the tool face with great pressure. To understand the role that strain hardening plays in tool wear it is necessary to speak of two types of welds. These are pressure and temperature welds. A pressure weld occurs at a surface temperature that is below the recrystallization temperature of the softer metal of the pair in contact. A temperature weld occurs when the surface temperature is above the recrystallization temperature.

All surfaces are relatively rough in terms of atomic dimensions. For either type of weld to occur, the metal at the surface must flow plastically so that the surfaces are brought close enough together to effect atomic bonds.

In the case of a pressure weld, the required flow will occur in the cold working region. Metal at the weld interface will be stronger than that of the metal in bulk. Thus, when the weld is broken, rupture occurs just beyond the weld interface in the unworked metal.

If the cutting speed (hence temperature) is low, pressure welds may be established. When these are broken upon subsequent sliding, weaker chip metal will be transferred to the tool face. If this procedure is repeated many times, a layer of material called a built-up edge is deposited on the tool face. The built-up edge grows until the forces to which it is subjected break

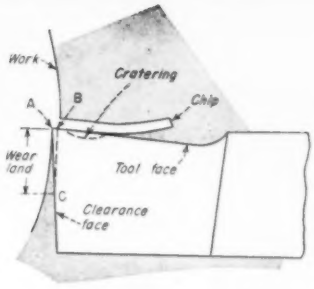


Fig. 1 . . Tool wear occurs in two areas: on the tool face and the clearance face. A wear land of 0.030 in. is considered permissible before carbide tools should be reground

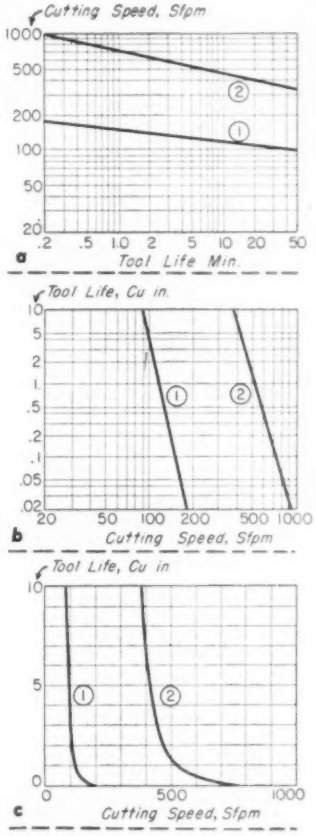


Fig 2 . . Tool-life curves for machining SAE 3140 at 0.0128 ipr and 0.050 in. depth of cut, using HSS (curve 1) and cemented carbide (curve 2). Log-log charts *a* and *b* obscure important aspects of tool life at various cutting speeds. Rectangular coordinates, as in chart *c*, are preferable to reveal when tool wear changes as cutting conditions change

it loose. Most of the old built-up edge becomes part of the finished surface. The remaining material passes off with the chip.

As the built-up edge is a consequence of pressure welding and the tendency for workpiece metal to strain harden, this material is very hard, Fig. 5. Actually, the built-up edge is responsible for wear of the plowing type on the clearance face of the tool.

When temperature welds are formed, the plastic flow necessary to bring the surfaces close enough together to establish the weld will occur without strain hardening. Hence, the surfaces will separate essentially in the plane at which they went together. There will be no tendency to form a build-up edge. On the other hand, when the surfaces separate, very small particles of the tool matrix will be plucked from the tool surface. The extent of this transfer type of wear depends upon the mean area that is subjected to temperature welds and the relative strengths of the tool and workpiece matrices.

When cutting speed is increased, the tendency to form welds of either type will decrease. This is true because it takes time for plastic flow to occur on an atomic scale.

Total weld area, Fig. 6, is a function of cutting speed. At very low speeds the surface temperature is low, and all of the weld area is of the pressure type. As the speed is increased temperature welds begin to appear. Finally, essentially all welds are of the temperature type and the built-up edge practically disappears.

Let us next consider the combined wear that results from:

1. Built-up edge debris arising from pressure welds.

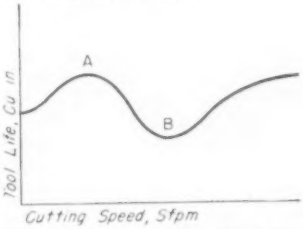


Fig. 3 . . General type of tool-life curve. Such hills and valleys do not always occur

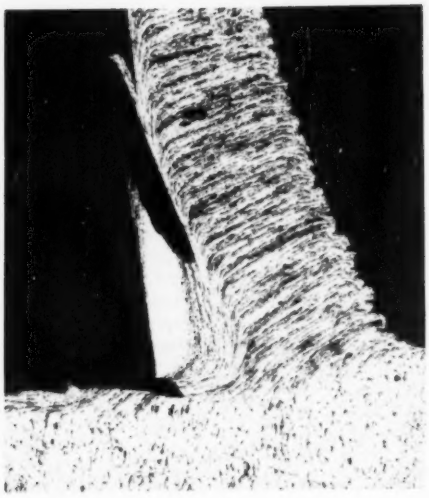


Fig. 4.. Large built-up edge and portions of built-up edge along finished surface and face of chip are revealed at 40 times magnification. SAE 1020 steel cut at 90 fpm

2. Hard particles.

3. Transfer from temperature welds.

To a first approximation, the rate of wear from pressure and temperature welds will be proportional respectively to the pressure and temperature weld areas. Thus, the rate of wear and curves (1) and (2) in Fig. 7*a* (wear per unit volume cut *vs* speed) were drawn in accordance with Fig. 6. A proportionality constant *b* for curve (2) is arbitrarily taken greater than the constant *a* for curve (1). The rate of wear (curve 3) due to the hard particles may, again as a first approximation, be considered constant with speed, because the number and size of these particles for a given specimen is independent of cutting speed. Solid curve (4) shows the resulting total rate of wear plotted against velocity. Tool life is inversely proportional to rate of wear, hence the tool-life curve corresponding to (4) is plotted as the reciprocal to produce the solid curve in Fig. 7*b*.

In the foregoing first approximation, the change in relative hardness of the workpiece and tool matrices has been ignored. Actually, as the cutting speed increases, the temperature of both workpiece and tool will increase. This increased temperature causes a decrease in the strength of the tool matrix, but the strength of the workpiece matrix will be essentially unchanged. The reason for this lies in the fact that it takes time for an increase in temperature to cause a decrease in strength. While the tool point is subjected to a static temperature, the temperature of the workpiece is very quickly changed as it passes across the zone of cutting. Hence, at high cutting speeds, the chip will have cleared the tool point before sufficient time has elapsed to cause a softening of the workpiece matrix. The net result is a loss of hardness of the tool matrix relative to the workpiece matrix at high cutting speeds, and hence an increase in the wear rate above that shown by the solid curve (4) in Fig 7*a*. The dash-line curve at *C*, *Fig.* 7*b*, illustrates the tool-life curve that might be expected when relative hardness is included in the picture. The relative position of point *C*, where the weakening effect of temperature on the tool becomes important, and the minimum at point *B*, will depend upon the tool material, the work material, and the cutting conditions.

The similarity of curves in Figs. 3 and 7*b* is evident. Both have a maximum at *A* and a minimum at *B*. The latter has been picturesquely described as the "valley of death." As previously mentioned, tool-life curves with such hills and valleys are not always found. Tool-life curves may have a number of different shapes depending on:

1. The mean speed corresponding to the transition from the pressure to the temperature type of weld (point *C* in Fig. 6).

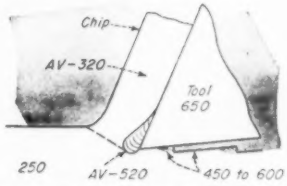


Fig. 5.. Wear on clearance face of tool arises from strain-hardened built-up edge (450 to 600 Brinell adhering to 250 Brinell work).

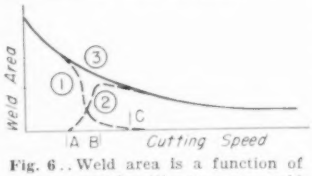


Fig. 6.. Weld area is a function of cutting speed: (1) pressure weld area, (2) temperature weld area, and (3) total weld area. Combined pressure and temperature welds occur only in region *AC*

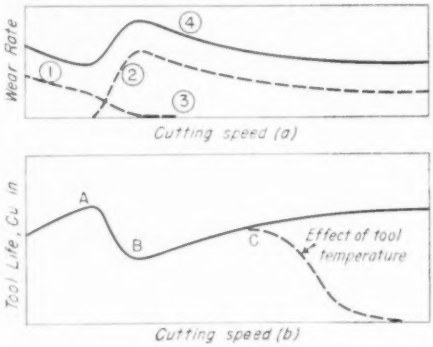


Fig. 7a.. Wear rate for pressure welds (1), temperature welds (2) and hard particles in the work material (3) are plotted according to arbitrarily assumed proportionality constants. Total wear is plotted in curve (4).

Fig. 7b.. Tool life is the reciprocal of wear rate, and is plotted as the solid line curve. At *C*, the decrease in tool life, as its temperature increases with speed, is made evident

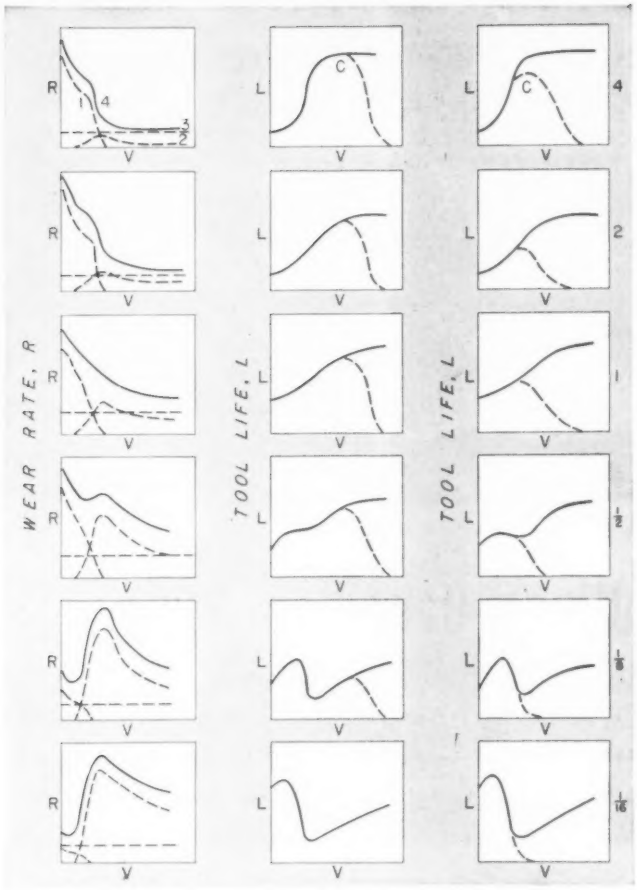


Fig. 8 . . Representative wear-rate curves for various materials are plotted in Col. 1. Tool-life curves shown in Col. 2 are derived from the wear-rate curves when values of proportionality constants a and b are selected according to the ratio a/b. Tool-life curves as in Col. 3 are obtained for different values of C (transition from pressure weld to temperature weld is assumed)

2. The shape of the total weld area *vs* velocity curve (3) of Fig. 6.

3. The relative values of the weld-area, wear-rate proportionality constants (a and b) for pressure and temperature welds (relative height of curves (1) and (2) of Fig. 7*a*).

4. The amount of hard-particle wear relative to the other types of wear (relative height of curve (3) of Fig. 7*a*.)

5. The speed at which tool softening sets in (point C of Fig. 6*b*).

A variety of tool-life-velocity curves are shown in Fig. 8. All of these were derived from the weld-area curves of Fig. 6, except using different values of the proportionality constants a and b and different values for speed C. A number of characteristic shapes of commonly observed experimental tool-life curves are evident here. Curves as shown in the lower right-hand corner of Fig. 8 ($a/b = 1/16$) are most frequently observed. When the life curve has this general form, it is evident that temperature-weld wear is more extensive than that due to pressure welds. While the detailed tool-life-velocity curve for a specific problem can only be obtained experimentally, the discussion presented here enables the qualitative aspects of such curves to be understood.

Just as the tool life varies with cutting speed, it will also vary with feed rate. At a low feed rate, the area of chip that passes across the tool surface will be relatively large for a given volume cut, and relatively small for a high feed rate. From this observation we should expect the tool life to increase with increasing feed rate. However, as feed rate increases, so do forces on the tool. As the area of contact on the clearance face of the tool will depend upon the size of the wear land, it is evident that the pressure on the clearance face for any condition of wear will increase with increased feed rate. This increased pressure will in turn give rise to a greater wear rate and hence decreased tool life with feed rate. It is evident that these two opposing influences of feed rate upon tool life give rise to an optimum rate of feed. The optimum feed rate is usually in the practical operating range and is most frequently from 0.010 to 0.020 ipr.

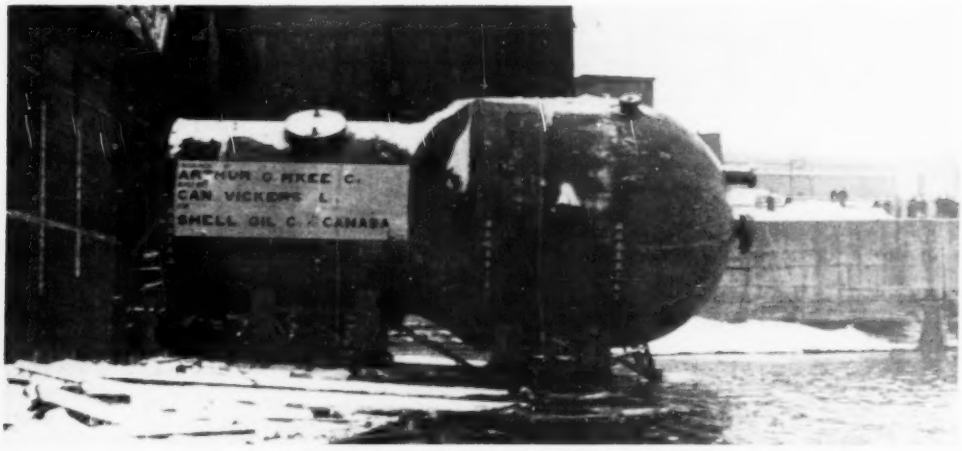
The concluding installment of "Metallurgical Considerations in Machining" will appear in an early number.

They say when he joins you, . . . you stay joined."

Lower section of regenerator, left, shown here upside down, was fabricated from 1-in. steel plate and welded to built-up lower dome. Skirt, of ⅝-in. plate, forms the base. Transition piece for change in dia was made in twelve sections. Hemispherical head, right, was made from crown plate and eight segments of ⅝-in. plate, and welded to the upper cylindrical shell. Arc welding was used throughout, and all welds were subjected to X-ray inspection, a total of 900 photographs being made

Materials Handling—Canadian Style

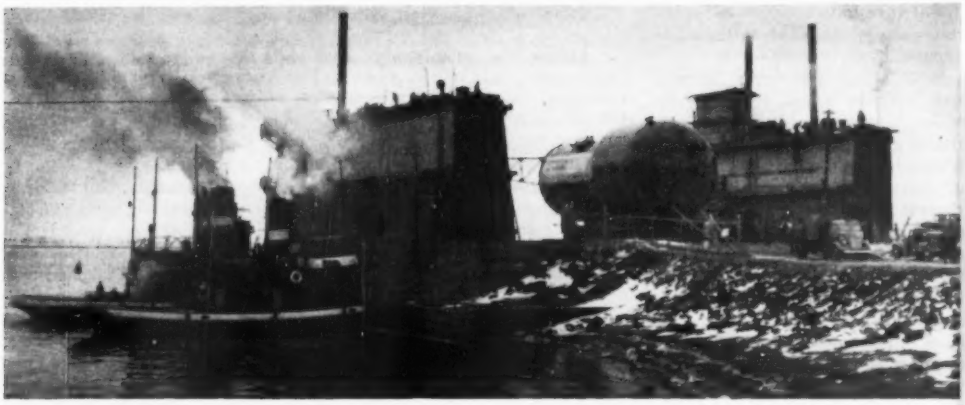
Nobody ever built a pressure vessel that big that way before. It had to be built in one piece to insure top-quality welds and 1/64-in. tolerances. They couldn't haul it through city streets and over bridges. So Canadian Vickers Ltd., Montreal built it on a slipway and launched it like a ship

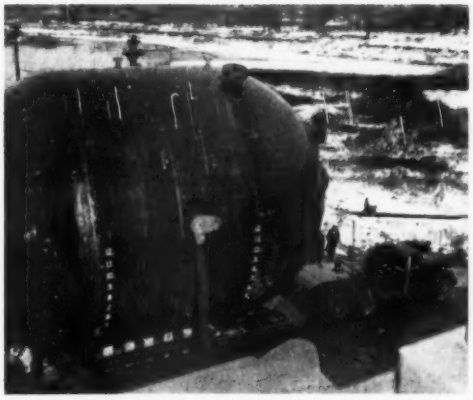


1 **Into the launching basin** slides the completed regenerator, less than 2½ months from the start of construction. Near-zero temperatures complicated the launching process by solidifying the grease on the slipway. Sand ballast weighed 20 tons, internal bracing 8 tons

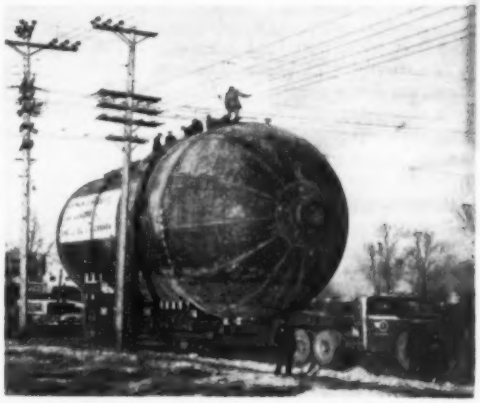
2 **Floating drydock** with two 16-wheel trailers was submerged under the unit, then carefully raised to position the 63-ft long, 27-ft dia, 133-ton load on the supporting cradles

3 **Moored to the pier head,** two tugs steady the dock against the pressure of current and a near-gale. Careful pumping raised the trailers to road level so a diesel tractor could back in and hook on. When the front end came ashore, dock level rose 8 in. and retrimming was necessary for landing the rear end





4 **All ashore!** After a six-mile river trip, the huge tank starts a nine-mile road journey to its destination. Ten loads of rock dust were used to provide traction on icy roads and to fill in holes. Eight tons of heavy plate strengthened weak spots to prevent tipping



5 **Last lap** through suburban streets involved moving two poles, 11 light brackets, 193 wires and cables. Trip took only 11 hr, and only mishap was one burst tire which had to be changed with the aid of four 50-ton jacks. Bulldozers stood by to steady the load around corners

• EASILY WORKED GLASS-PLASTICS • SAVE TIME • SAVE MATERIAL

BY FRANK CHARITY, LOS ANGELES, CALIFORNIA

Fibers of glass bonded with plastic resins have high tensile strength; are readily formed. Six methods are used, individually or combined, to shape the material. Consolidated Vultee, North American Aviation, and Boeing are using glass-plastics with good results and a considerable saving in aluminum, steel alloys, and production time

COMPARED with other materials, glass fibers and plastic resins are fairly expensive. However, experience in the aircraft industry has proved that, aside from their unique physical qualifications, glass-plastic parts can be fabricated with such economy that initial expenditures for raw materials can be regarded as inconsequential.

Steel, aluminum, copper, bronze, and Kirksite alloys are used to make metal molds for the fabrication of glass-plastic materials; and, where high-gloss surfaces are required, the molds are usually chrome plated. Non-metallic molds of the plaster type are readied for use by sealing with lacquer or shellac; then, like metal molds, they are lubricated with wax, stearic acid, petroleum jelly, silicone fluids, or comparable release agents (usually depending on the types of resins used as binders for glass fibers in different circumstances).

In aircraft work, glass-plastics are used with particular success in fabricating large parts, such as ducts, presently required in fairly limited quantities. This normally involves contact molding, or laminating, and is particularly advantageous in that it minimizes tooling costs without a sacrifice in finished-part quality.

For example, where a lengthy duct might be produced as a sequence of metal stampings (which would require a preliminary investment of at least $5000 in temporary dies), a glass-plastic duct can now be made as a single unit (which requires no supplemental assembly or finishing operations) with a plaster die worth less than $300.

In terms of tensile or compressive strength alone, glass-plastic parts are not as strong as the best steel and aluminum-alloy parts. However, glass-plastics have tremendous flexural strength and can, in many circumstances, withstand impacts or blows which would cause comparable metal products to fail.

Further, when a glass-plastic part is damaged, repair can be accomplished with relative ease—simply by reinforcing damaged areas with new glass fibers (if necessary) and a catalyzed resinous binder.

The glass materials are spun-fiber products now manufactured as fabrics and as mats by Glass Fibers, Inc., Waterville, Ohio; Wilmington Chemical Corp., New York, N. Y.; and Fiberglas Corp., Toledo, Ohio. The plastics include phenolformaldehyde resins produced by companies such as Durez Plastics & Chemicals, Inc., at North Tonawanda, N. Y., and thermosetting polyester resins made by B. F. Goodrich Chemical Co., Cleveland, Ohio; American Cyanamid Company, New York, N. Y.; Resinous Products & Chemical Company, Philadelphia, Pa.; and Pittsburgh Plate Glass Co, Pittsburgh, Pa.

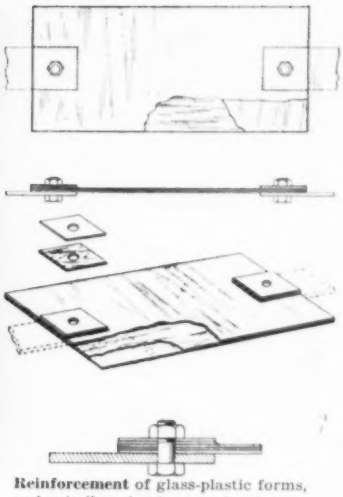
Purpose of the liquid plastic resins is to impregnate and bind glass fibers, much the same as cement is dispersed in water to bind particles of sand and gravel in making concrete.

A few material manufacturers (such as Monsanto Chemical Company of Springfield, Mass.) now produce resin-impregnated glass fiber mats in a ready-to-mold condition, thus saving fabricators the time and cost of buying and using special impregnation equipment. However, aircraft manufacturers seem to prefer to do their own prefabrication work, as this makes it possible to combine a greater variety of materials to produce parts with special physical properties.

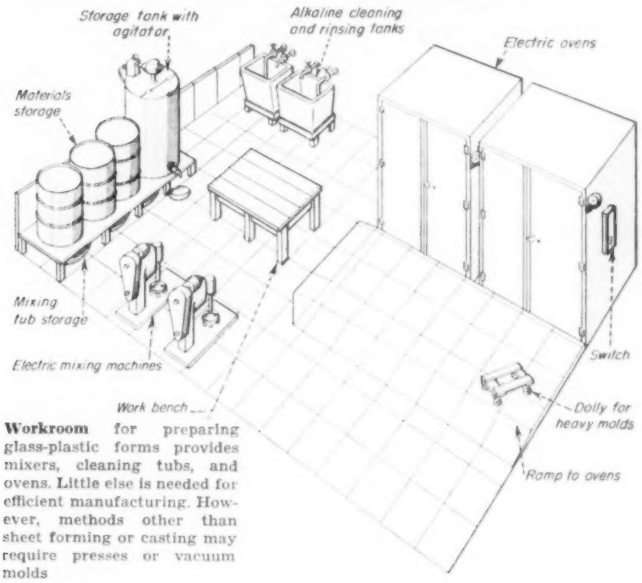
The latter properties include: less weight than the lightest aluminum alloys, as much tensile and compressive strength as could be attained with most magnesium alloys, extreme chemical inertness (even in the presence of strong acid or alkaline solutions), more vibration resistance than the best grades of spring steel, and variable degrees of flexibility or rigidity and transparency or opacity.

Prior to impregnation operations, plastic binding mediums are mixed with catalytic agents so that they can be rapidly heat-set or solidified with little or no pressure. This is frequently done with a mechanical mixer of the type used

Glass-plastic auto body was built-up on inexpensive wood forms. It is said to withstand impacts that would rupture a steel body. If damaged, repair is quickly accomplished by an inexperienced person. A soft mixture of glass-fiber and plastic is packed into the hole, allowed to set, and then sanded smooth. Body was built by Industrial Plastics Corp., Gardena, Calif.



Reinforcement of glass-plastic forms, and similar laminates, is accomplished by arranging alternate sheets so that the fibers are at 90°. Washers are used where holes have been drilled to minimize the weakening effect of "crazing"



Workroom for preparing glass-plastic forms provides mixers, cleaning tubs, and ovens. Little else is needed for efficient manufacturing. However, methods other than sheet forming or casting may require presses or vacuum molds

by bakeries; and, when the catalyst is thoroughly dispersed, the liquid mix is transferred to an impregnation tray or tank.

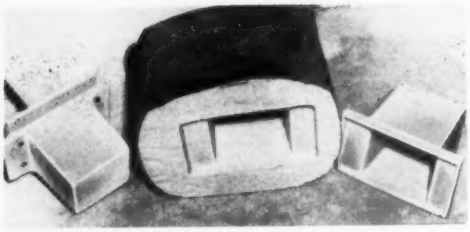
Mechanically powered rollers are used to pass glass mat or fabric materials through the impregnation tank, so that the fibers will be thoroughly wetted. The roller arrangement is designed to drain excess quantities of resin from the fibers as the latter emerge from the impregnation tank.

Plastic-impregnated materials may be stored for several days or weeks prior to fabrication work, or they may be used immediately to make finished parts.

Methods of fabricating the resin-glass materials are:

Preform process which uses a wire-screen mold mounted on a turntable in a vacuum chamber. Materials are loaded loosely in the center of the mold, and the latter is rotated as air is evacuated from the chamber so that centrifugal forces and negative pressure will uniformly align the materials over the surfaces of the mold cavity within a few minutes. Preforms thus produced are subsequently heat-cured with cast-alloy dies and simple pneumatic press equipment at temperatures up to 350 F. This process has the advantage of minimizing material losses, resulting from the production of "flash" in molding finished articles, but is more or less limited to the fabrication of parts with symmetrical shapes and small dimensions.

Compression molding, with or without preforms, as noted above, when fairly large quantities of identical products are required. Virtually all types of molds and compression presses can be used



Photographic development tank compression-molded from glass-plastic material. Shown l to r ,are the plaster male die, the plaster female die, and the tank. This method is very rapid for making emergency equipment and prototypes, as well as production items

Plaster mold surfaces are lubricated prior to wrapping them with the resin-impregnated glass-fiber materials. Here an aircraft air duct is being formed of many layers of glass-plastic. Many hours of intricate sheet-metal work are eliminated

for this work, but the less-expensive tools are usually preferred as parts can be finish molded with pressures of 25 psi and less than 350 F in operational cycles ranging from 30 sec to 3 min.

Contact molding or laminating, useful where extremely large products must be duplicated, or where small quantities of identical parts are required. Materials are loaded on or in low-cost forms or molds (which frequently comprise cast plaster). Then the loaded tools are placed in airtight retainers (such as cellophane bags), which are evacuated to provide contact pressures.

Warm sunlight, infra-red heaters, and low-temperature ovens have been used to cure glass-plastic materials at contact pressures in periods of about 30 min.

Rubber-plunger molding which is a variation of the Guerin process, used in forming sheet metal. This consists of using a rubber forming head to apply pressure to glass-plastic materials in a cast-metal female mold, and is advantageous as a, sometimes, very practical method of minimizing compression-press tooling costs.

Continuous laminating by the use of squeeze rolls to feed glass-plastic materials through a hot-air chamber to produce flat sheets, which are subsequently sheared to suitable stock lengths. This process is principally useful for high-speed, fully automatic production.

Postforming, a process whereby glass-plastic materials are partly cured as flat sheets, so they can be readily molded to a desired shape with a final press operation. This allows the fibers in a product to be aligned or orientated for maximum mechanical strength.

Molded, or laminated, glass-plastic materials seldom require finishing because their binding mediums are the same as coating resins and may be pigmented prior to solidification where translucent or opaque color effects are desired. However, the materials can be finished after they are fabricated (if necessary in unusual circumstances) with paints, lacquers, enamels, and other conventional coatings; no primers are required.

Glass-plastic aircraft parts are normally assembled by bonding with the same resins used to bond the parts. As a rule, parts are designed so assembly joints will be subjected to shear (rather than tensile) stresses and loads on the assemblies will be uniformly distributed over relatively large areas.

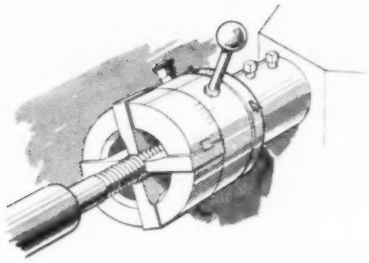
Second Operations

Where glass-plastic parts (such as leading or trailing edges for aircraft wings) must be assembled with parts comprising metals or other materials, bonding techniques have also been used with some success. However, the usual practice in such circumstances is to join the parts with rivets and bolts.

Fabricated glass-plastics can be drilled, punched, sawed, tapped, threaded, milled, planed, shaped, or sheared with only a few variations from standard metalworking processes, hence riveting and bolting are practical. Woodworking tools of the types used in machining ordinary plastic moldings or casts are not suitable cutting tools. Glass-plastics are extremely tough and abrasive, hence carbides and other first-quality metalworking tools are necessary, and most satisfactory if operated at relatively slow speeds, adequately cooled with an air blast or stream of water.

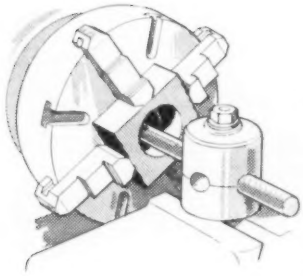
Slow cutting speeds are required to prolong the lives of cutting tools in machining glass-plastic materials. Constant cooling is necessary to prevent the "crazing" or burning which minimizes bond strength of plastic constituents; but where the use of coolants is impractical, as in the drilling of glass-plastics, the effects of crazing can be reduced by washers or similar reinforcements to shield the crazed areas.

As heretofore intimated, the resinous constituents of glass-plastics can be damaged by heat. However, with the best types of thermo-setting binders, the new materials can be described as non-flammable because they are self-extinguishing and will not support combustion.



How to Machine Copper Alloys

BY LESTER F. SPENCER
Chief Metallurgist
LANDERS FRARY & CLARK
NEW BRITAIN, CONN.



COPPER, and its wide variety of alloys, commonly classified as brasses and bronzes, frequently presents the production executive with some of his toughest problems. Free-cutting brass, machinability rating 100, is about the easiest to machine of all materials, and is often said to "cut like butter." But even small changes in composition frequently produce major changes in the ease with which stock can be removed and a fine finish obtained.

The old rules of thumb for speeds, feeds, and cutter angles are no longer adequate for today's many and varied compositions. Maximum production and lowest costs can be obtained only if all of the many variables have been taken into consideration, and due allowances made for them.

In this American Machinist Special Report, the various alloys have been divided into three major groups, according to their machinability ratings, and specific recommendations are made for each group. Feeds, speeds and tool cutting angles are suggested for the common machining operations, but it must be borne in mind that these are not to be considered as hard and fast rules. Rather, they represent average practice as followed by many manufacturing concerns. Each operation, and each individual machine, may require some modification of the figures given, depending upon circumstances, if maximum efficiency is desired. If, however, the tables presented here are used as a basis, there should be no difficulty in making the necessary adjustments.

A SPECIAL American Machinist REPORT TO THE METALWORKING INDUSTRIES

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MACHINABILITY RATINGS

MACHINABILITY, a term often encountered in Metalworking, can be considered as the relative ease in forming a material by metal removal; this term being evaluated by such factors as: (a) productivity in pieces per unit time; (b) power requirements of a given machine in performing the cutting operations; (c) surface finish of the completed part; (d) accuracy to specified dimensions; and (e) tool life in terms of pieces per grind. In considering the copper-base alloys, the machinability factor is markedly increased with the additions of small amounts of lead, usually from 1.0 to 4.0%, depending upon the base composition of the alloy. This becomes quite evident when one considers pure copper whose low hardness and tenacity makes it difficult to machine. However, by the addition of as low as 1.0% lead, cutting speeds can be materially increased so its machinability is almost on a par with the free cutting leaded brasses. The addition of lead will decrease the ductility and malleability of the material, but the electrical conductivity, tensile strength, and hardness are not affected to any great extent.

The relative machinability of copper and copper alloys can be roughly classified into three groups:

Group 1—the free-cutting alloys;

COMPOSITION AND MACHINABILITY RATING OF THE COPPER BASE ALLOYS

Name	Group	Chemical Composition, %						Rating*
		Cu	Ni	Zn	Pb	Sn	Others	
Leaded Copper	1	99.0	—	—	1.0	—	—	80
Leaded Com. Bronze	1	88.5	—	10.0	1.50	—	—	80
Hardware Bronze	1	85.0	—	13.25	1.75	—	—	90
Leaded Low Brass, 80	1	78.5	—	20.0	1.5	—	—	90
Leaded Brass	1	69.0	—	29.5	1.5	—	—	90
Butt Brass	1	64.0	—	35.0	1.0	—	—	70
Free-Cutting Yellow Brass	1	62.0	—	35.0	3.0	—	—	100
Forging Brass	1	60.0	—	38.0	2.0	—	—	80
Extruded Architectural Bronze	1	56.0	—	41.5	2.5	—	—	80
Leaded Naval Brass	1	60.0	—	37.25	2.0	0.75	—	80
Special Free Cutting Phosphor Bronze	1	88.0	—	4.0	4.0	4.0	—	90
Extruded Leaded Nickel Silver	1	46.5	10.0	40.75	2.75	—	—	80
Low Red Brass, 85%	2	85.0	—	15.0	—	—	—	30
Low Red Brass, 80%	2	80.0	—	20.0	—	—	—	30
Yellow Brass	2	63.0	—	37.0	—	—	—	40
Muntz Metal	2	60.0	—	40.0	—	—	—	40
Naval Brass	2	60.0	—	39.25	—	0.75	—	30
Tobin Bronze	2	60.0	—	39.25	—	0.75	—	30
Manganese Bronze	2	59.0	—	39.0	—	0.70	Mn 0.5; Fe 0.8	30
Leaded Phosphor Bronze	2	94.0	—	—	1.0	5.0	—	50
Leaded Nickel Silver	2	65.0	12.0	22.0	1.0	—	—	50
Leaded Nickel Silver	2	63.25	18.0	17.75	1.0	—	—	50
Everdur, 1010	2	95.8	—	—	—	—	Mn 1.1; Si 3.1	30
Everdur, 1012 leaded	2	95.6	—	—	0.4	—	Mn 1.0; Si 3.0	60
Everdur, 1015	2	98.25	—	—	—	—	Mn 0.25; Si 1.5	30
Elec. T.P. Copper	3	99.90+	—	—	—	—	—	Note: all alloys in Groups 3 have rating equal to or less than 20.
Deoxidized Copper	3	99.90+	—	—	—	—	P 0.02	
90% Com. Bronze	3	90.0	—	10.0	—	—	—	
4% Phosphor Bronze	3	95.75	—	—	—	4.0	P 0.25	
5% Phosphor Bronze	3	95.0	—	—	—	5.0	—	
8% Phosphor Bronze	3	92.0	—	—	—	8.0	—	
10% Phosphor Bronze	3	90.0	—	—	—	10.0	—	
18% Nickel Silver	3	65.0	18.0	17.0	—	—	—	
19% Nickel Silver	3	55.0	18.0	27.0	—	—	—	
Ambrac	3	75.0	20.0	5.0	—	—	—	
Super Nickel	3	69.6	30.00	—	—	—	Fe 0.4	
Ambraloy, 5%	3	95.0	—	—	—	—	Al 5.0	
Ambraloy, 8%	3	92.0	—	—	—	—	Al 8.0	
Ambraloy	3	82.0	5.0	—	—	—	Mn 1.0; Fe 2.5; Al 9.5	
Avialite	3	89.25	0.50	—	—	0.4	Fe 0.6; Al 9.25;	
Beryllium Copper	3	97.4	0.35	—	—	—	Be 2.25	
Chromium Copper	3	99.05	—	—	—	—	Si 0.1; Cr 0.85	

* Approximate relative machinability rating

Turning Feeds and Speeds for Carbide Tools

Group	Surface Speed, fpm	Roughing Feed, ipm	Finishing Feed, ipm
1	300-700	0.006-0.020	0.003-0.015
2	150-300	0.015-0.035	0.005-0.015
3	75-150	0.015-0.040	0.005-0.020

Based on roughing cut of approximately 0.045-0.125 in., and finishing cut of 0.015-0.030 in. For carbon-steel tools, reduce speeds by one-half. Work to lower side as dia increases.

Turning Feeds and Speeds for High Speed Steels

Group	Rough Surface Speed, fpm	Roughing Feed ipm	Finishing Surface Speed, fpm	Finishing Feed ipm
1	400-800	0.015-0.025	500-1000	0.005-0.015
2	300-500	0.015-0.030	400-600	0.005-0.015
3	250-600	0.015-0.030	300-800	0.008-0.015

Based on roughing cut of approximately 0.045-0.125 in. and finishing cut of 0.015-0.030 in.

usually brasses, to which a high percentage of lead has been added. This group includes those alloys with a machinability rating of 70 to 100, the index of machinability being the free-cutting yellow brass which is rated at 100. These alloys are most frequently produced in rod form for the production of screw-machine parts, and produce short brittle chips.

Group 2—the more readily machinable alloys whose index of machinability is 30 or more, but less than 70.

Group 3—those alloys with a machinability index of 20 or less. These usually produce long, tough, stringy chips.

A machinability rating, such as tabulated here, must be considered as approximate. However, it can serve as a reasonable guide as to both the relative tool-life expectancy and power requirements necessary for cutting. The line of demarcation of each group is not too well defined; it will be found that the machinability of a specific alloy, under certain conditions, is such that it might be classified under a different group.

Feeds and Speeds

Because the variables of speed, feed, and depth of cut present an unlimited number of possible combinations, it is difficult to state accurately the cutting speeds to be employed. However, it is recommended to use the highest practical cutting speed with relatively light feed and moderate depth of cut. The only exception to this rule is in the machining of sand castings, where the opposite procedure is likely to give the best results. Even after sand blasting, pickling and/or tumbling, most sand castings retain an extremely hard and abrasive surface scale. It has been recommended that low turning speeds and coarse feeds be employed and, by overcoming the eccentricity of the casting in one cut if possible, tool life is greatly extended. After this initial cut, higher speeds and lighter feeds may be used to advantage. Speeds usually need not be reduced for the initial cut where carbide tooling is used on castings.

Machining speed is usually controlled by the efficiency of the cutting medium in removing the generated heat. If this heat can be carried away at a rate sufficient to prevent softening of the tool and the welding of the alloy on the tool, it is quite possible that the cutting speeds may be unlimited.

The efficiency of the coolant-lubricant, and the manner and speed in which the chip is carried away from the tool control the temperature of the work and the tool. Within Group 1, the leaded alloys, the chip breaks up at a rapid rate, resulting in but momentary contact with the tool. This, along with the high machining speed usually employed with this group, necessitates that the cutting medium operate primarily as a coolant rather than as a lubricant. Also, both the rake angle and clearances are at a minimum; the small rake angle breaks the chip almost immediately, and the reduced clearance provides the cutting edge with greater support.

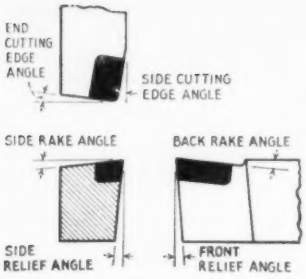
Where the alloy to be machined is within the more ductile group (Groups 2 and 3) there is likely to be a welding action between the work and the tool. Thus, the cutting medium must serve primarily as a lubricant, and the resultant loss of its cooling characteristics will necessitate a reduction in spindle speed. Rake and clearance angles must be increased to start the chip flowing off the tool as rapidly as possible; the greater clearance is necessary to prevent build-up on the face of the tool from producing a rubbing or burnishing action. Usually, it is better to keep both clearance and rake angles on the low side of the permissible range, so cutting edge support is not sacrificed. This is governed to some extent by the finish obtained on the cutting tool in grinding.

On high tensile strength alloys, such as the aluminum silicon bronzes, much heat is produced, despite the brittle chip, by the toughness of the material itself. Being intrinsically harder, these alloys produce considerably more heat through friction, and at the same time actually wear the cutting material much faster than the more standard alloys.

TURNING AND BORING PRACTICE

Automatic screw machines are used extensively, particularly where production demands are quite high. Within this category, there are three essential variations; the single-spindle automatic which is characterized by high spindle speeds and relatively light feeds; the Swiss-type automatic which is adaptable where accuracy is essential, and for long slender parts with tapers and shoulders, and the heavy-duty, multi-spindle machine which is rugged and able to take cuts at medium to heavy feeds.

In turning, the type of tool used depends on both the design of the part and the amount of material to be removed. Where material removal is considerable, a roughing tool removes the bulk of the



Nomenclature for carbide-tipped and plain tools. Angles are more critical on carbide tools, but even on plain tools, too great a relief angle may cause chatter and poor finish

CUTTING ANGLES FOR SINGLE-POINT TOOLS

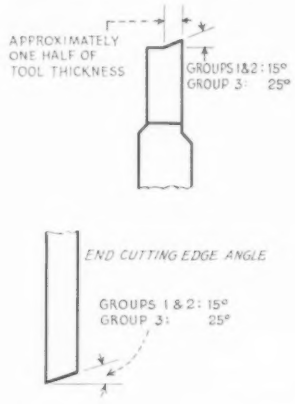
	HIGH-SPEED & CARBON TOOLS			CARBIDE-TIPPED TOOLS		
	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3
End Cutting Edge Angle	8-15°	8-15°	8-15°	8-15°	8-15°	8-15°
Side Cutting Edge Angle	10-15°	10-15°	15°	10-15°	10-15°	10-15°
Side Rake	0-3°	5-10°	20-30°	2-6°	4-8°	15-25°
Side Relief Angle	0-5°	5-10°	10-20°	4-6°	4-8°	7-10°
Back Rake Angle	0°	5-10°	10-20°	9°	0-5°	4- 8°
Front Relief Angle	6°	6-15°	10-15°	4-6°	4-8°	7-10°

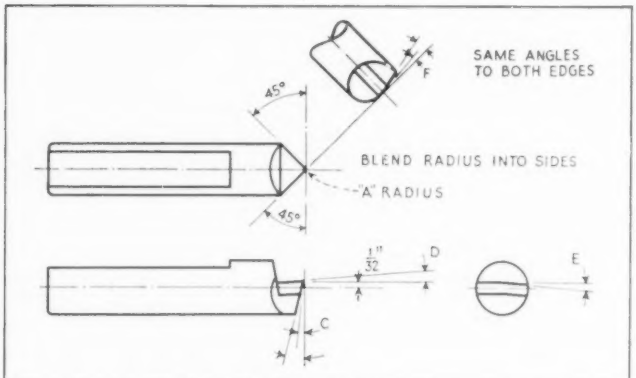
End cutting edge angle should be satisfactory for most rough and finish turning operations. When the end cutting edge of a finishing tool is ground with a drag, or parallel with the axis, considerably heavier feeds may be employed on light finishing cuts. Tools should be ground and set so the tool point is on center with the effective rake angles in correct relationship to the center line of the work.

On carbide-tipped tools, rake angles are based on the tool shank being set parallel with the center line of the work and with the tool point on the center. Placing the tool point above or below the center will change the effective rake angle appreciably, particularly on work of small diameter. On a setup where the tool holder is not parallel with the center line, the rake angles should be ground so that when the tool is mounted, they are in correct relation.

stock, and is followed by a finishing cut. This will increase tool life. The roughing operation can be performed with the balance turning tool, or the plain, or adjustable hollow mill. The former is preferred because it is rugged, adjustable over a wide range of size, and the simple, square blades are easy to grind and set. It cannot be used when one or both cross-slides of the single-spindle automatic are brought into action immediately after rough turning, because of the clearing time required. In such cases, and where long, small-dia pieces must be turned to size, the plain or adjustable hollow mill is used.

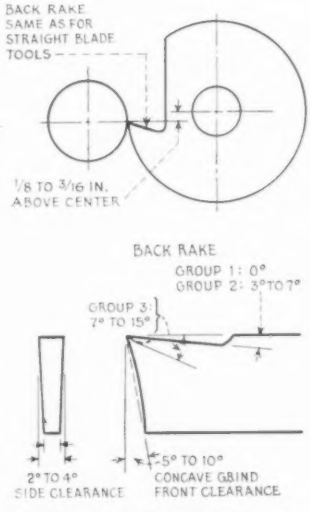
The plain hollow mill is primarily a roughing tool and is designated for single-stock size; the use of floating holders and an abundance of cutting fluid are usually recommended. As there is but a slight clearance between the dia of the turned stock and the hole in the mill, a periodic check on turned diameter is usually required to determine whether the mill is cutting to proper size. The three-tooth hollow mill is usually preferred as, in our experience, less chatter will result. The adjustable





CLASS	CUTTING SPEED	D (DEG.)	E (DEG.)	COOLANT
1	800-3,000	0	5	DRY; PARAFFIN OIL; SOL. OIL 20 TO 1
2	450-1,500	0 TO 5	5 TO 10	SOL. OIL; MIN. OIL + 10% LARD OIL
3	200-800	5 TO 10	15 TO 20	MIN. OIL + 20% LARD OIL

Coolants and angles for finish boring with carbide tools, as shown in this chart, have proved satisfactory in many cases. However, some changes may have to be made to suit a particular job

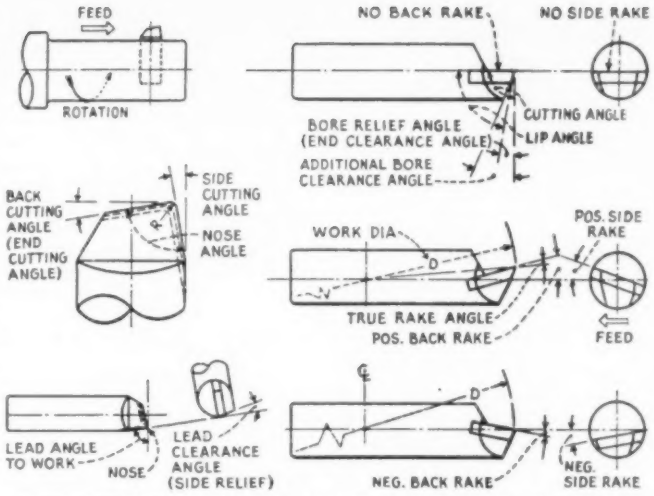

BACK RAKE SAME AS FOR STRAIGHT BLADE TOOLS
1/8 TO 3/16 IN. ABOVE CENTER
BACK RAKE
GROUP 1: 0°
GROUP 2: 3° TO 7°
GROUP 3: 7° TO 15°
2° TO 4° SIDE CLEARANCE
5° TO 10° CONCAVE GRIND FRONT CLEARANCE

Suggested rake and clearance angles for straight and circular cutoff tools

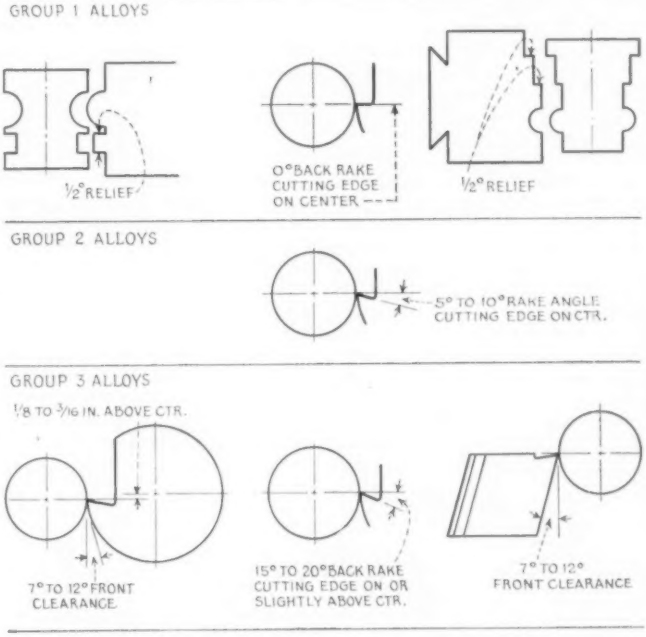
hollow mill has inserted blades with independent radial adjustment and, because of its larger size as compared to the plain hollow mill, sufficient time for removal must be given in planning sequential operations in the single-spindle machine. It has been suggested that the cutting edges be parallel to the radii and ahead of or above the center by 0.010 to 0.015 in.

Box tools are used to a considerable extent for finishing cuts in the single-spindle automatic. They are adjustable over a large range of diameters; two or three tools can be mounted in a holder for turning different diameters, facing shoulders, or pointing the work; and they offer support in turning long slender parts. The box tool is also used frequently as a roughing tool on multi-spindle automatics. On box tools for fine finishes on the leaded, low-copper alloys, the face of the tool should be ground parallel with the axis. The feeds will vary from 0.006 to 0.012 in. depending upon the depth of cut and the capacity of the particular machine

The suggested rake and relief angles for lathe tools are given in an accompanying table. As indicated, little or no rake is required for the less ductile alloys of Group 1, whereas the more ductile alloys of Groups 2 and 3 require greater rakes. The values also indicate that the type of tool material is a determining factor. As mentioned above, Group 1 alloys are machined at the highest practicable spindle speed, the feeds being adjusted to suit such conditions as depth of cut, available power, coolants and finishing requirements. A nose radius of 1/16 to 1/8 in. is satisfactory for roughing cuts with high speed or carbon steel tools. With carbide, it should be held to a minimum, not exceeding 1/16 in.



Terminology for single-point boring tools. These are frequently misunderstood, but the terms shown here may be considered as standard for tools of this type



Suggested rake and clearance angles for circular and dovetail form tools

Form and Cutoff Tools

The circular cutoff tool, operating from the cross-slide of the single-spindle machine, is used for small-dia work and is provided with sufficient bevel for side clearances. Because cutoff tools are frequently fed into drilled or threaded holes, the circular type is more rigid and will withstand greater shock than the flat blade type. Standard straight-blade, high speed cutoff tools with designed toolholders can be satisfactorily used; these usually have sufficient taper for side clearances and need be ground only for top rake where required, and on the front end for the necessary clearance.

If the parting is deep, causing binding or galling of the tool, it may be necessary to have an addi-

tional side clearance on a circular cutoff tool of from ½ to 1°.

The circular form tool is used to advantage in the single-spindle automatic, and the dovetail type in the multi-spindle machine and engine lathe. Selection of tool material is usually governed by production requirements. In large-scale production, where the operation is flat shoulder forming or recessing, and no complicated contours are required, carbide-tipped flat form tools have given exceptional service in reducing tool wear and maintaining close tolerances. In general, the speeds and feeds used with form tools are controlled by the width of the tool in relation to the work dia, the amount of overhang and the shape of the contour. Roughing form tools wider than 1½ times the dia of the stock may result in chatter, poor tool life and an inability to hold to close tolerances. Where a form tool wider than this width/dia ratio is required, it is better to use matching form tools, each mounted in a separate position on the cross-slides. When machining with high-speed form tools, it is good practice to adjust only the cutting speeds to the alloy being machined, and to maintain a light feed; 0.001 to 0.003 in. for roughing and 0.0005 to 0.002 in. for finishing, with generous quantities of cutting fluid.

DRILLING AND REAMING

Accuracy in drilling is of vital importance, especially when subsequent operations are located from the first drilled hole. For alloys in Groups 1 and 2, flat and straight-flute drills, having a natural 0° rake angle, are used in screw-machine work. In deep hole drilling, the slow spiral or "brass" drill, with a decreased helix angle of 10 to 22°, and with wide polished flutes and a thin web to provide large chip clearance with a decreased rake angle, is often used. For Group 3, where the chips are tough and stringy, high spiral drills with a helix angle of approximately 40° are being used successfully. The greater number of twists per inch provides the desired increased rake angles and assists in ejecting the chips, particularly in deep drilling.

In drilling deep holes, the following suggestions may be of aid: (a) use decreasing helix; (b) use two straight flutes; (c) rotate drills opposite to work to remove chips and obtain greater cutting speeds; (d) drill to depth equal to 5 times dia of hole, then remove the drill and finish with a second operation; (e) half-round drills reduce the time 50%; however, start the hole with the usual twist drill to center properly.

Factors such as drill dia, wall thickness of the work, and depth of hole will control both the speed and feed of the operation. The feeds employed will vary in accordance with drill diameter and depth of hole; thus, lighter feeds are used on small drills, for deep holes, and where accuracy is desired. Heavier feeds are used on the larger drills.

Dry drilling of the copper alloys is often practiced; however, a lubricant is recommended, especially in Groups 2 and 3 where accuracy in deep-hole drilling is expected. In hand feeding, it is essential to apply adequate and constant pressure on the work-hardening alloys, such as beryllium copper. When backing out the drill to relieve chip congestion, it is necessary, upon reinsertion of the drill, that contact with the bottom of the hole be made during a period of positive cutting pressure.

DRILLING SPEEDS

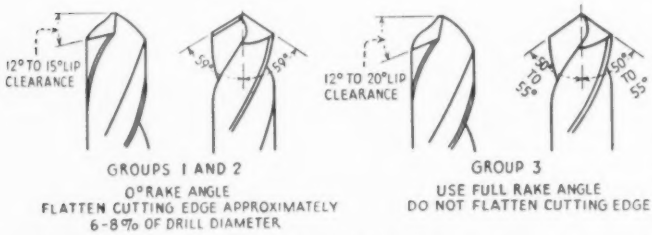
ALLOY	FPM
Group 1	200-500
Group 2	75-250
Group 3	50-125

For carbon-steel drills, reduce speeds approximately 50%

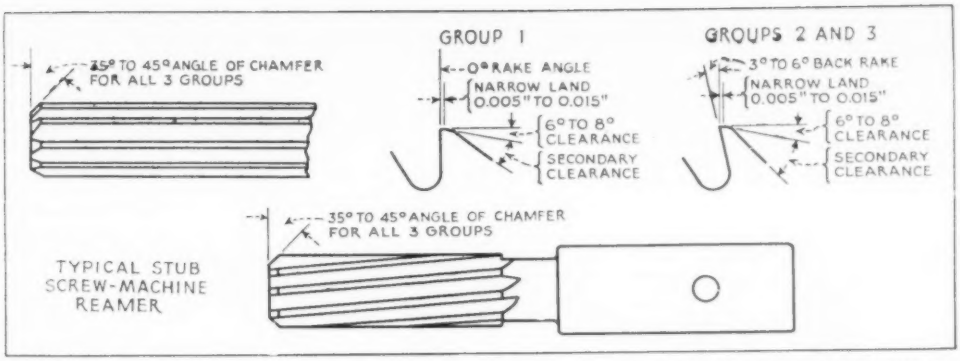
DRILLING FEEDS

DIAMETER	FEED	
	DEEP HOLES	SHALLOW HOLES
0.020		0.0015
0.040		0.002
0.0625		0.004
0.0938	0.005	0.012
0.125	0.005	0.015
0.188	0.010	0.020
0.250	0.010	0.014
0.312	0.010	0.016
0.625	0.010	0.016
Center drills under 0.125		0.003
Center drills over 0.125		0.006

Although all standard types of hand and machine reamers are used on the copper-base alloys, straight-fluted and spiral-fluted reamers are most common. Straight-fluted reamers with narrow lands and polished flutes may have a tendency to chatter; this can be overcome by use of a spiral reamer with a helix angle of approximately 7 to 12°. These reamers will also produce a finer finish. Left-hand spiral, right-hand cut reamers for either straight or tapered holes give excellent results on all three alloy groups. It must be remembered that ample metal should be left for reaming so a continuous



Drill point and clearance angles for cutting copper alloys. These can usually be obtained by regrinding standard drills, as shown


GROUP 1
GROUPS 2 AND 3
35° TO 45° ANGLE OF CHAMFER FOR ALL 3 GROUPS
0° RAKE ANGLE
NARROW LAND 0.005" TO 0.015"
6° TO 8° CLEARANCE
SECONDARY CLEARANCE
3° TO 6° BACK RAKE
NARROW LAND 0.005" TO 0.015"
6° TO 8° CLEARANCE
SECONDARY CLEARANCE
35° TO 45° ANGLE OF CHAMFER FOR ALL 3 GROUPS
TYPICAL STUB SCREW-MACHINE REAMER

Reamer angles and clearances for standard, straight-flute reamers, and the typical stub, screw machine reamer

bite can be realized and burnishing action avoided. This will protect the reamer from excessive wear and possible failure. It is especially important where the wall thickness is small in relation to the hole dia and where the work-hardening alloys are used.

Clearances should be sufficient to avoid binding, and it is suggested that stoning all cutting edges after grinding, to remove wheel marks, results in smoother and more accurate holes and longer tool life. Reaming speed will depend on such factors as dia of hole, length of hole, and wall thickness.

The feed will vary with depth of cut, finish requirements, type of machine, lubricant, and tolerances required. Suggested feed in holes less than ⅛ in. is 0.007 to 0.010 in. and holes over ⅛ in., 0.010 in.

Tapping and Chasing

Tapping is usually a follow-through of drilling or reaming, and its success is directly related to the condition of the hole. Possibly the greatest reason for torn threads or broken taps is the selection of a tap drill that is too small or too nearly the size of the root dia. Where a specified thread fit is not required, and where the depth of hole is at least equal to the dia of the tap, a 75 or 80% depth of thread is sufficient. A 100% thread is only 5% stronger than a 75% thread, yet requires more than twice the power to tap and presents problems of chip ejection and correct tap design for the particular metal.

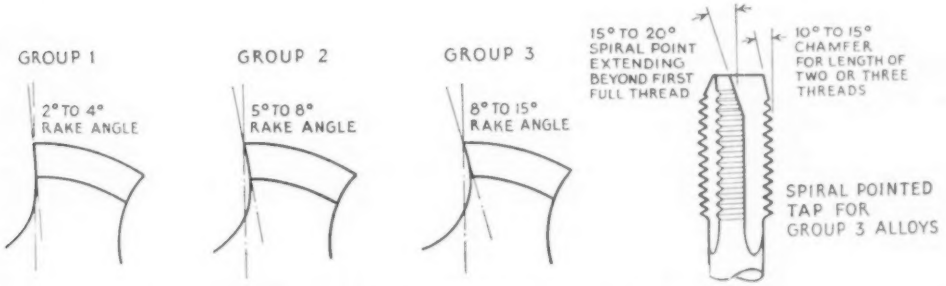
REAMING SPEEDS

ALLOY	SPEED FPM
Group 1	200 max.
Group 2	75-150
Group 3	60-90*

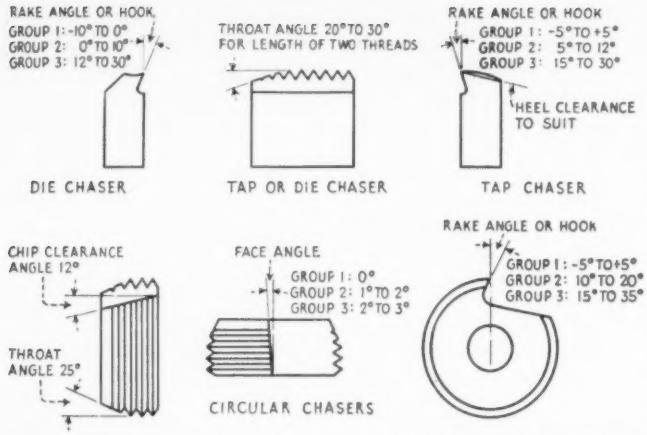
* Spiral reamers.
For carbon-steel reamers, reduce speed approximately 50%

The regular two-, three-, and four-fluted taps with narrow lands, and polished flutes, with a two- or three-thread chamfer, is usually satisfactory for Groups 1 and 2 for machine tapping. For Group 3 alloys, particularly copper, nickel silver, and the Super-Nickel, which produce tough, stringy chips, spiral-pointed taps with two or three flutes are preferred for tapping through holes or blind holes drilled sufficiently deep for chip clearance. These taps produce long curling chips which are forced ahead of the tap. They cut freely, producing excellent threads, and because the design permits shallow fluting, tool breakage is usually reduced to a minimum.

An accompanying table gives suggested rake angles and speeds based upon the use of high speed taps, and for fine to moderate pitch threads. Appreciably lower speeds should be used on coarse-pitch threads and with carbon steel taps. On a spiral-pointed tap for Group 3 alloys, a 15 to 20° spiral point extending beyond the first full


GROUP 1
2° TO 4° RAKE ANGLE
GROUP 2
5° TO 8° RAKE ANGLE
GROUP 3
8° TO 15° RAKE ANGLE
15° TO 20° SPIRAL POINT EXTENDING BEYOND FIRST FULL THREAD
10° TO 15° CHAMFER FOR LENGTH OF TWO OR THREE THREADS
SPIRAL POINTED TAP FOR GROUP 3 ALLOYS

Tap rake angles should be correct for the class of material being tapped. If threads tear as tap is backed out, grind a rake angle on both sides of the flutes


RAKE ANGLE OR HOOK
GROUP 1: -10° TO 0°
GROUP 2: 0° TO 10°
GROUP 3: 12° TO 30°
DIE CHASER
THROAT ANGLE 20° TO 30°
FOR LENGTH OF TWO THREADS
TAP OR DIE CHASER
RAKE ANGLE OR HOOK
GROUP 1: -5° TO +5°
GROUP 2: 5° TO 12°
GROUP 3: 15° TO 30°
HEEL CLEARANCE TO SUIT
TAP CHASER
CHIP CLEARANCE ANGLE 12°
THROAT ANGLE 25°
FACE ANGLE
GROUP 1: 0°
GROUP 2: 1° TO 2°
GROUP 3: 2° TO 3°
CIRCULAR CHASERS
RAKE ANGLE OR HOOK
GROUP 1: -5° TO +5°
GROUP 2: 10° TO 20°
GROUP 3: 15° TO 35°

Modification of chasers for die heads and collapsible taps is important for clean-cut threads. The angles are usually greater than on other types of tools

thread is employed, with a 10 to 15° chamfer for the length of two or three threads.

Circular, radial, and tangential thread chasers for self-opening die heads, and die chasers for collapsible taps are satisfactory for both internal and external threading of copper, brass and bronze on all types of automatic screw machines. High speed steel chasers will give satisfactory service; however, service life, and production of clean, sharp threads are dependent upon correct grinding practice for the specific alloy to be machined and the use of a satisfactory cutting fluid. The rake angles and clearances given in the illustration can be used as a starting point; however, these can be modified by relation of the pitch to the dia of the thread, the thread form, and the fit required. The following cutting speeds are for threads of moderate pitch; Group 1, 100 to 150 fpm; Groups 2 and 3, 50 to 90 fpm. On coarse threads, speeds in the lower range should be used. On automatic screw machines working the leaded alloys, maximum spindle speed is frequently used when threading small-dia work or parts with fine-pitch threads.

Milling

Milling speeds given in the table may vary considerably because of the varied conditions of milling which may be present. Such factors as depth of cut, width of cut, machine rigidity, desired finish, and rate of feed will have a decided influence.

The suggested rake angles and clearances are a good starting point; however, these values may be greatly modified because of the wide variety of cutters and the diversified nature of machining operations which may be classified as milling. With Group 3 alloys, some experimentation with clearance angles may be desirable. Thus, on the non-leaded nickel silvers, phosphor bronzes, super nickel and copper-silicon alloys, a clearance of 5 to 10° has been successfully used, while on non-leaded copper a clearance of 12 to 15° has been found more effective. As a general rule, smothest finishes are obtained with helical or spiral-tooth cutters, as these cut with a shearing action and, as a result, cut more freely, have less chatter, and tend to resist hogging in, even on the free-cutting alloys of Group 1. Adequate rake and clearance must be incorporated in the tool, and the width of land held to a minimum. As a general rule, the clearance behind the cutting edge should be sufficient to avoid rubbing or burnishing. Excessive vibration and hogging in are usually indications of too much rake or clearance, or too much speed.

Coarse-tooth cutters are preferred because they are under less strain and usually permit higher speeds. They reduce the cutting pressure, and the additional space between the teeth provides better chip clearance. Staggered-tooth side milling cutters with alternate spiral teeth are suggested for deep slotting operations. This is particularly true when machining Group 3 alloys. Spiral-fluted end mills are fast cutting and produce a better finish than those with straight flutes. For right-hand cuts, the flutes should be right-hand spiral. As per suggestion from Anaconda: (a) the double angles on the back of the teeth are standard regrinding practice and will give the cutter edge adequate clearance and strength; (b) the clearance angle should be greater for small cutters than for the larger ones; (c) the maximum clearance angles are suggested for cutters which are approximately 3 or 4 in. in dia; (d) only the face of the tooth is ground on form and gear cutters, this being done radially to preserve the cutting form of the tooth. On this type of cutter the clearance remains constant for the life of the tool.

Grinding

Diamond turning of copper and copper alloys has generally replaced grinding where finish and size are important. Because of this, grinding is not used as extensively, and usually only where no other type of machining will do the job.

The ductility and malleability

Tapping Speeds

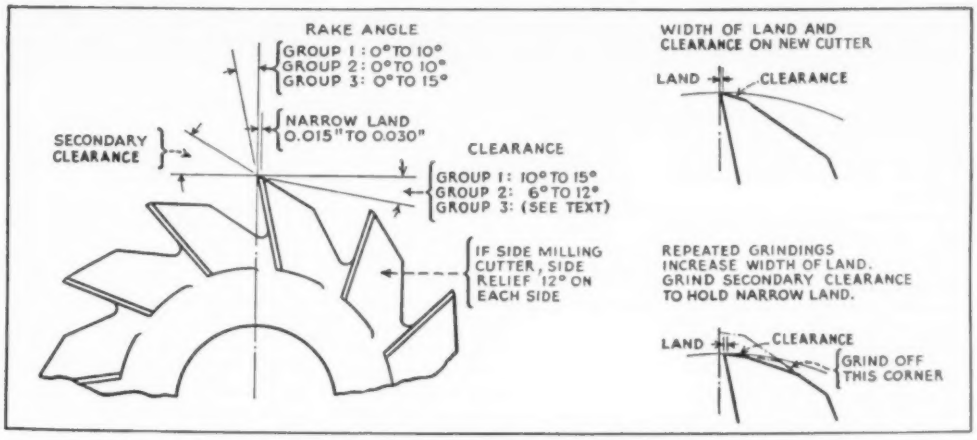
Alloy	Rake Angle deg.	Speed fpm
Group 1	2 to 4	150-250
Group 2	5 to 8	60-150
Group 3	8 to 15	60-30

Speeds are based on high speed taps and fine to moderate pitches. Reduce speeds for coarser pitches. For carbon steel taps, reduce speed 50%

Milling Speeds

Alloy	Speed fpm
Group 1	200-250
Group 2	150-200
Group 3	50-150

Use lubricant. Reduce speed 50% for carbon steel cutters


RAKE ANGLE
GROUP 1 : 0° TO 10°
GROUP 2 : 0° TO 10°
GROUP 3 : 0° TO 15°
SECONDARY CLEARANCE
NARROW LAND 0.015" TO 0.030"
CLEARANCE
GROUP 1 : 10° TO 15°
GROUP 2 : 6° TO 12°
GROUP 3 : (SEE TEXT)
IF SIDE MILLING CUTTER, SIDE RELIEF 12° ON EACH SIDE
WIDTH OF LAND AND CLEARANCE ON NEW CUTTER
LAND
CLEARANCE
REPEATED GRINDINGS INCREASE WIDTH OF LAND. GRIND SECONDARY CLEARANCE TO HOLD NARROW LAND.
LAND
CLEARANCE
GRIND OFF THIS CORNER

Rakes and clearance angles for standard milling cutters. Cutting may be dry, but soluble oil is often used. On pure copper a light cutting oil diluted with 50% kerosene gives best results

of the material causes it to flow rather than be cut by grinding wheels. Loading is one of the major problems in Groups 1 and 2. When grinding dry, loading can be reduced by using a wheel treated with paraffin or wax. When grinding wet, a water-emulsion type of coolant, with high lubricity, should be used to retard loading.

When tensile strength and hardness are increased, the grinding problem is decreased. Metals of high tensile strength, usually harder and less ductile, are ground best with fused aluminum oxide, while the more ductile metals require silicon-carbide abrasives.

Sawing

Band saws having "raker" teeth (one tooth to the left, next tooth straight, and next tooth to the right, etc.) with 10 to 14 teeth per in. are recommended in cutting manganese bronze, and under average conditions should operate at 150 to 350 fpm. The copper-silicon alloys require 10 to 12 teeth per in., raker set, and operate within the same range of speed. Normally, on band saw machines, a pitch of 6 to 10 teeth per in. will cover most of the copper base alloys and 4 to 6 teeth per in. on hack-saw machines. However, as in other operations, some experimental work may be necessary to obtain the correct saw tooth for

SAWABILITY RECOMMENDATIONS FOR COPPER ALLOYS

	Condition	Rockwell B	Saw Velocity fpm	Saw Pitch 1/16-¼	¼-¾	¾-1½	1½+
Copper	Hard	58	2000	10	6	4	3
Low Brass	Hard	75	1000	14	10	6	4
Red Brass	Hard	74	500	14	10	6	4
Red Brass	Soft		750	14	10	6	4
Cartridge Brass	Hard	88	350	14	10	4	3
Cartridge Brass	Soft	20	500	14	10	4	3
Extra-High-Leaded Brass	Hard	87	1000	14			
Naval Brass	Hard	55	500	14	10	6	3
Naval Brass	Soft		1000	14	10	6	3
Phosphor Bronze	Soft		600	14	10	6	4
Aluminum Brass	Hard	86	300	14	10	6	4
Manganese Bronze	Hard	90	200	14	10	6	3
Cast Manganese Bronze	Hard		200	14	10	6	3
Cupro Nickel			300	14	10	6	3
Low-Silicon Bronze	Hard	80	300	14	10	6	3
High-Silicon Bronze	Hard		200	14	10	6	4

SUGGESTED WHEELS FOR GRINDING COPPER AND BRASS

Low-Strength Alloys

Operation	Abrasive	Grit-Size	Process	Wheel Speed fpm
Snagging	Silicon Carbide	16-36	Vitrified	5500-6000
Cylindrical	Silicon Carbide	36-60	Vitrified	5500-6000
Internal	Silicon Carbide	36-60	Vitrified	5500-6000
Surfacing	Silicon Carbide	24-36	Vitrified	4500-5000
Cut-off	Silicon Carbide	24-36	Resinoid	10,000-15,000

High-Strength Alloys

Operation	Abrasive	Grit-Size	Proces	Wheel Speed fpm
Snagging	Aluminum Oxide	16-36	Vitrified	5500-6000
Cylindrical	Aluminum Oxide	24-60	Vitrified	5500-6000
Internal	Aluminum Oxide	36-60	Vitrified	5500-6000
Surfacing	Aluminum Oxide	24-36	Vitrified	4500-5000
Cut-off	Aluminum Oxide	24-36	Resinoid	10,000-15,000

Standard Commercial Wrought Coppers and Copper-Base Alloys

NAME	Composition % NOMINAL	Form Most Commonly Ordered: ROLLED FLAT	ROD AND DRAWN FLAT	SHAPES	WIRE (EXCEPT FLAT)	TUBE	Physical Properties: MELTING POINT (LIQUIDUS)	MELTING POINT (SOLIDUS)	POUNDS PER CU. IN. (@ 68° F)	MACHINABILITY RATING
COPPERS										
Electrolytic Tough Pitch	Cu 99.92 O 0.04	x	x	x	x	x	1981°F	1949°F	0.321-0.323	20
Deoxidized	Cu 99.94 P 0.02	x	x	x		x	1981°F		0.323	20
PLAIN BRASSES — NON-LEADED										
Gilding, 95%	Cu 95 Zn 5	x	x		x		1950°F	1900°F	0.320	20
Commercial Bronze, 90%	Cu 90 Zn 10	x	x		x	x	1910°F	1870°F	0.318	20
Red Brass, 85%	Cu 85 Zn 15	x	x		x	x	1880°F	1810°F	0.316	30
Low Brass, 80%	Cu 80 Zn 20	x	x		x		1830°F	1770°F	0.313	30
Cartridge Brass, 70%	Cu 70 Zn 30	x	x		x	x	1750°F	1680°F	0.308	30
Yellow Brass (Flat Products)	Cu 65 Zn 35	x	x				1710°F	1660°F	0.306	30
Yellow Brass (Wire)	Cu 65.3 Zn 34.7	x	x		x		1710°F	1660°F	0.305	30
Muntz Metal	Cu 60 Zn 40	x	x		x	x	1660°F	1650°F	0.303	40
LEADED BRASSES										
Leaded Commercial Bronze	Cu 89 Pb 1.75 Zn 9.25		x	x			1900°F	1850°F	0.319	80
Low-Leaded Brass (Tube)	Cu 67 Pb 0.5 Zn 32.5					x	1720°F	1660°F	0.307	60
Low-Leaded Brass	Cu 64.5 Pb 0.5 Zn 35	x					1700°F	1650°F	0.306	60
Medium Leaded Brass	Cu 64.5 Pb 1 Zn 34.5	x	x	x	x		1700°F	1630°F	0.306	70
High-Leaded Brass (Tube)	Cu 67 Pb 1.6 Zn 31.4					x	1710°F	1650°F	0.308	80
High-Leaded Brass	Cu 62.5 Pb 1.75 Zn 35.75	x	x				1670°F	1630°F	0.306	90
Extra-High-Leaded Brass	Cu 62.5 Pb 2.5 Zn 35	x					1660°F	1630°F	0.307	100
Free-Cutting Brass	Cu 61.5 Pb 3 Zn 35.5		x	x			1650°F	1630°F	0.307	100
Leaded Muntz Metal	Cu 60 Pb 0.5 Zn 39.5	x					1650°F	1630°F	0.304	60
Free-Cutting Muntz Metal	Cu 60.5 Pb 1.1 Zn 38.4					x	1650°F	1630°F	0.304	70
Forging Brass	Cu 60 Pb 2 Zn 38	x	x	x			1640°F	1620°F	0.305	80
Architectural Bronze	Cu 57 Pb 3 Zn 40		x	x			1630°F	1610°F	0.306	90
TIN, ALUMINUM BRASSES										
Admiralty	Cu 71 Sn 1 Zn 28	x			x	x	1720°F	1650°F	0.308	30
Naval Brass	Cu 60 Sn 0.75 Zn 39.25	x	x	x	x	x	1650°F	1630°F	0.304	30
Leaded Naval Brass	Cu 60 Sn 0.25 Pb 1.75 Zn 37.5									
Manganese Bronze (A)	Cu 58.5 Sn 1 Fe 1		x	x			1650°F	1630°F	0.305	70
	Mn 0.3 Zn 39.2	x	x	x	x		1630°F	1590°F	0.302	30
Aluminum Brass	Cu 76 Al 2 Zn 22					x	1780°F	1710°F	0.301	30
PHOSPHOR BRONZES (TIN BRONZES)										
Phosphor Bronze, 5% (A)	Cu 95 Sn 5 P 0.03-0.35	x	x		x	x	1920°F	1750°F	0.320	20
Phosphor Bronze, 8% (C)	Cu 92 Zn 8 P 0.03-0.35	x	x		x		1880°F	1620°F	0.318	20
Phosphor Bronze, 10% (D)	Cu 90 Sn 10 P 0.03-0.25	x	x		x		1830°F	1550°F	0.317	20
Phosphor Bronze 1.25% (E)	Cu 98.75 Sn 1.25 P-Trace	x					1970°F	1900°F	0.321	20
CUPRO-NICKEL AND NICKEL SILVERS										
Cupro-Nickel, 30%	Cu 70 Ni 30	x	x			x	2260°F	2140°F	0.323	20
Nickel-Silver, 18% (A)	Cu 65 Ni 18 Zn 17	x	x		x		2030°F	1960°F	0.316	20
Nickel-Silver, 18% (B)	Cu 55 Ni 18 Zn 27	x	x		x		1930°F	—	0.314	30
SILICON BRONZES (COPPER-SILICON ALLOYS)										
High-Silicon Bronze, (A)	Traces of six metals Cu 94.8 min. Si 3	x	x	x	x	x	1880°F	1780°F	0.308	30
Low-Silicon Bronze, (B)	Traces of six metals Cu 96 min. Si 1.5	x	x	x	x	x	1940°F	1890°F	0.316	30

In addition to the alloys listed here, there are many other special and proprietary types available, such as aluminum, aluminum-tin, aluminum-silicon, cadmium, and silicon bronzes, beryllium coppers, and copper-chromium alloys.

Fabrication Properties				Suitability For Being Joined By:				
COLD-WORKING PROPERTIES	HOT-WORKING PROPERTIES	HOT-WORKING TEMPERATURE	ANNEALING TEMPERATURE	SOFT SOLDERING	SILVER ALLOY BRAZING	OXYACETYLENE WELDING	CARBON ARC WELDING	RESISTANCE WELDING
Excellent	Excellent	1400-1600°F	700-1200°F	Excellent	Good	Poor	Fair	Poor
Excellent	Excellent	1400-1600°F	700-1200°F	Excellent	Excellent	Fair	Good	Poor
Excellent	Good	1400-1600°F	800-1450°F	Excellent	Excellent	Fair	Good	Poor
Excellent	Good	1400-1600°F	800-1450°F	Excellent	Excellent	Good	Good	Poor
Excellent	Good	1450-1650°F	800-1350°F	Excellent	Excellent	Good	Good	Poor
Excellent	Fair	1500-1650°F	800-1300°F	Excellent	Good	Good	Fair	Poor
Excellent	Fair	1350-1550°	800-1400°F	Excellent	Good	Good	Fair	Fair
Excellent	Poor	–	800-1300°F	Excellent	Good	Good	Fair	Fair
Excellent	Poor	–	800-1300°F	Excellent	Good	Good	Fair	Fair
Fair	Excellent	1150-1450°F	800-1100°F	Excellent	Good	Good	Fair	Fair
Good	Poor	–	800-1200°F	Excellent	Fair	Fair	Fair	Poor
Excellent	Poor	–	800-1200°F	Excellent	Good	Fair	Fair	Fair
Good	Poor	–	800-1300°F	Excellent	Good	Fair	Fair	Fair
Good	Poor	–	800-1200°F	Excellent	Good	Fair	Fair	Poor
Fair	Poor	–	800-1200°F	Excellent	Good	Fair	Fair	Poor
Fair	Poor	–	800-1100°F	Excellent	Good	Fair	Fair	Poor
Poor	Fair	1300-1450°F	800-1100°F	Excellent	Good	Fair	Poor	Poor
Poor	Fair	1300-1450°F	800-1100°F	Excellent	Good	Fair	Poor	Poor
Fair	Excellent	1150-1450°F	800-1100°F	Excellent	Good	Fair	Poor	Poor
Fair	Excellent	1150-1450°F	800-1100°F	Excellent	Good	Fair	Poor	Poor
Fair	Excellent	1200-1500°F	800-1100°F	Excellent	Good	Fair	Poor	Poor
Poor	Excellent	1150-1350°F	800-1100°F	Excellent	Good	Fair	Poor	Poor
Excellent	Fair	1200-1450°F	800-1100°F	Excellent	Good	Good	Fair	Fair
Fair	Excellent	1200-1500°F	800-1100°F	Excellent	Good	Good	Fair	Fair
Poor	Good	1200-1400°F	800-1100°F	Excellent	Good	Fair	Poor	Poor
Poor	Excellent	1150-1450°F	800-1100°F	Excellent	Good	Good	Fair	Good
Excellent	Fair	1400-1600°F	800-1100°F	Good	Good	Good	Good	Good
Excellent	Poor	–	900-1250°F	Excellent	Good	Good	Good	Good
Good	Poor	–	900-1250°F	Excellent	Good	Good	Good	Excellent
Good	Poor	–	900-1250°F	Excellent	Good	Good	Good	Excellent
Excellent	Good	1450-1600°F	900-1200°F	Excellent	Excellent	Good	Good	Fair
Good	Good	1700-1900°F	1200-1500°F	Excellent	Excellent	Good	Fair	Excellent
Excellent	Poor	–	1100-1500°F	Excellent	Excellent	Good	Fair	Excellent
Good	Poor	–	1100-1500°F	Excellent	Excellent	Good	Poor	Excellent
Excellent	Excellent	1300-1600°F	900-1300°F	Excellent	Excellent	Excellent	Excellent	Excellent
Excellent	Excellent	1300-1600°F	900-1250°F	Excellent	Excellent	Excellent	Excellent	Excellent

maximum production. A good rule for selecting saw pitch is to decrease the number of teeth for heavy sections, and increase for thin sections. Solid tooth, high speed steel circular saws used for bronze may have either straight or topped teeth ground radially if the saw arbor is above the work, or with a 10° hook when the arbor is below the work. Speeds of 400 to 600 fpm can be used with feeds up to 30 to 50 ipm. Rates of feed on circular saw blades can be increased with increases of saw thickness. Beeswax is sometimes used as a lubricant, but cutting is usually done dry.

Skiving and Swing Tools

The skiving tool is used extensively on the single-spindle automatics and turret lathes for forming irregular diameters. The speeds and feeds used for operation of the skive tool are similar to those for forming tools. The face of the tool block below the cutting edge is usually ground back 10 to 12° for clearance.

The swing tool is quite versatile, being used for either straight or taper turning, forming, or cutoff. It is employed in straight turning on applications where neither the box tool nor the hollow mill can be used, or where the circular form tool on the cross-slide cannot be applied. It is also used where slender pieces require a long cut. In taper turning, the swing tool should be fed slow enough to obtain a smooth finish. The swing tool cut is made without support, provided the work is rigid; however, if desired, a support or back rest can precede the tool blade. The swing tool may be used for forming or cutoff when the available slide positions on the single-spindle automatic are already occupied by other forming tools. At times, this tool is also used for recessing, internal boring and chamfering.

Swing tools are inclined at about 12° to the horizontal. For the leaded, low-copper alloys, the top face is ground 12° to make it horizontal, and with 0° top or back rake. For the free-cutting, high-copper alloys, the angle of grinding should be slightly greater than 12° to provide some back rake. The cutting edge may be raised slightly above center to improve surface finish.

FEEDS FOR SWING TOOLS

	Width of Cut, in.	Feed in.
FORMING	1/8-1/4	0.0012-0.002
	3/8-1/2	0.0008-0.001
STRAIGHT TURNING	1/32	0.008
	1/16	0.006
	1/8	0.005
	3/16	0.004

Lubricants and Coolants

The function of a lubricant is three-fold: (a) it serves as a coolant to reduce the temperature of the cutting tool, and thereby preserves its hardness and prolongs tool life; (b) as a lubricant, it provides a film of oil between the work and the cutting tool, thereby reducing abrasion and erosion; (c) as an anti-weld agent where such elements as sulfur are added to the cutting fluid, reduction or elimination of a built-up deposit on the cutting edge by high cutting pressures and temperatures may be realized. The coolant property of a lubricant is the main characteristic desired in machining alloys where high cutting speeds are permissible. In machining at lower speeds used on the tougher alloys, lubrication and anti-weld characteristics become more desirable. The specific recommendation of a cutting fluid to cover a wide range of alloy compositions is quite difficult; however, the lubricants given below will serve as a guide, and experimental work will determine the correct lubricant for any specific case.

Group 1

A light mineral oil is usually all that is required. A 100 viscosity paraffin oil is being used successfully in machining those alloys requiring high speed, light feed, and moderate depth of cut. Water solubles can also be used but, in the case of automatics, some objections may be offered because of the possibility of dilution of the machine lubricant. This is especially true where the automatic is old.

Group 2

A mineral base oil fortified with 5 to 15% lard oil will prove satisfactory as both a lubricant and a coolant, the higher percentage of lard oil being used on those alloys producing tough stringy chips.

Group 3

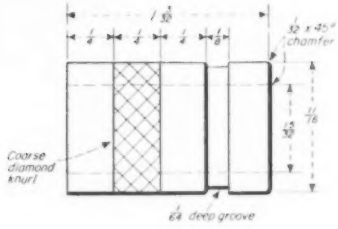
A frequently used cutting fluid for this group is a mineral oil base with 10 to 20% lard oil. For copper and alloys with a high nickel content, a sulfurized mineral oil or a sulfurized mineral lard oil also gives excellent results. When a sulfurized compound is used, the parts should be cleaned as soon as possible after machining, to avoid discoloration. The tarnish can be removed by a 20-min immersion in a 10% sodium-cyanide solution.

GENERAL PROCEDURES

On a large percentage of of screw-machine parts, the length of time required for the longest single operation determines the total machine time for the completed part. It is therefore apparent that any decrease in machining time on such operations as drilling, reaming, tapping, and threading, results in a corresponding increase in over-all production. Thus, three of the more important factors that determine the maximum economy in production would be, (a) material to be machined; (b) lubricant and (c) cutting tool material.

Ordinarily, operations such as drilling, reaming, tapping and threading, when performed on free-cutting yellow brass (rated 100), do not require any reduction in cutting speed. On other copper base alloys of Group 1, maximum economy can be realized by proper choice of lubricant and cutting tool material. With Groups 2 and 3, slower speeds are necessary; but lubricant and tool material will aid considerably in obtaining the

TYPICAL COPPER ALLOY SCREW MACHINE PRODUCTS



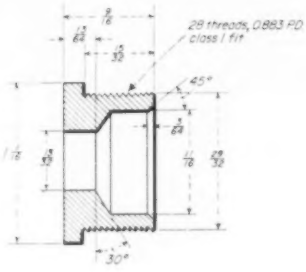
Machine: 2 1/4 New Britain Gridley

Material: 11/16 ODx3/8 ID Leaded Naval Brass

Copper	60.0 %
Zinc	37.25%
Tin	0.75%
Lead	2.00%

OPERATIONAL SEQUENCE

Turret	Slide
1. Spot	1. Face and groove
2. Drill part way	
3. Drill to depth	2. Knurl
4. Chamfer	
5. Ream	3. Cut-off



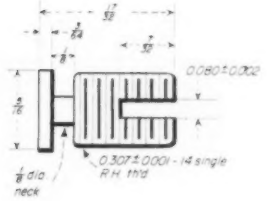
Machine: 2 1/4 New Britain Gridley

Material: Leaded Naval Brass

Copper	60.0 %
Zinc	37.25%
Tin	0.75%
Lead	2.00%

OPERATIONAL SEQUENCE

Turret	Slide
1. Spot	
2. Drill large hole	1. Rough form
3. Drill small hole	2. Finish form
4. Break corners on flange	
5. Chamfer	
6. Thread	3. Cut-off



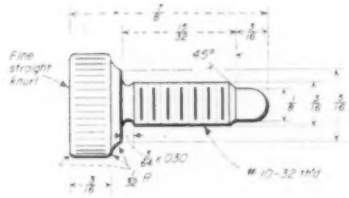
Machine: 0 Brown & Sharpe

Material: 5/16 Dia 10% Leaded Nickel Silver

Copper	46.50%
Nickel	10.00%
Zinc	40.75%
Lead	2.75%

OPERATIONAL PROCEDURE

1. Stop
2. Turn thread dia (box tool)
3. Rough thread (open die)
4. Finish thread (open die)
   Form (front slide)
   Cut-off (back slide)



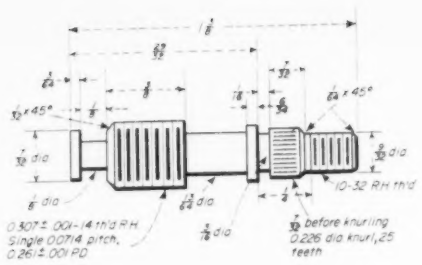
Machine: 0-C Brown & Sharpe

Material: 7/16 Dia Free-Cutting Yellow Brass

Copper	62.0 %
Zinc	35.0 %
Lead	3.0 %

OPERATIONAL PROCEDURES

1. Stop
2. Turn (box tool)
3. Knurl head
4. Form (back slide)
5. Thread
   Cut-off (front slide)



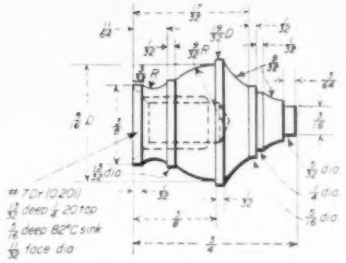
Machine: O-G Brown & Sharpe

Material: 10% Leaded Nickel Silver 5/16 Dia

Copper	46.50%
Nickel	10.00%
Zinc	40.75%
Lead	2.75%

OPERATIONAL PROCEDURES

1. Stop
   Partial form (front slide) turret support
2. Thread
3. Finish form (front slide) revolving support
4. Rethread
5. Cut-off and form (back slide)
   Feed to 2nd stop



Machine: O Brown & Sharpe

Material: 5/8 Dia Leaded Commercial Bronze

Copper	88.50%
Zinc	10.00%
Lead	1.50%

OPERATIONAL PROCEDURE

1. Stop
2. Center
3. Drill
4. Tap
   Skive (Front slide)
   Cut-off (Back slide)

highest practicable speed on the machine and, in operations, such as drilling and reaming, the coarsest feeds that the work and the tools will permit.

Cutting-tool materials may vary from plain carbon to high speed steel and carbide tipped; the choice usually being on the basis of both production and material machined. The high speed tools are frequently used, especially in applications involving drilling, tapping, solid and inserted-tooth reaming, and for milling cutters. The chief advantage offered, besides longer tool life, is the permissible higher speeds attainable in these operations; these two factors may more than offset the added cost of tooling. Within the high speed steel compositions, the different types exhibit various stages of toughness and cutting ability. In the cobalt types (9.0 to 12.0% cobalt) cutting efficiency is at a maximum, but toughness is the lowest in the high speed bracket. In the molybdenum-cobalt and tungsten-cobalt types (cobalt 5.0%) the toughness factor increases with the cutting efficiency decreasing. Both the tungsten and molybdenum types exhibit maximum toughness within this group.

The tungsten-carbide tipped tools are frequently used on high-production items, particularly on castings and other machining operations where large amounts of stock must be removed. This type of tool has high resistance to both abrasion and heat; but its shock resisting properties are lower than those exhibited by the high speed steels. Because of lower tool wear, they are apt to produce closer dimensions and finer finishes for longer runs with less down-time for tool grinding and resetting.

Operational procedures on automatic equipment, as well as feeds and speeds, may vary within the industry because of such variables as type of tool material employed; type, concentration and rate and direction of lubricant flow; type and condition of equipment; accuracy; and finish requirements. In many instances, allowable speeds of each operation within a sequence are determined, and the lowest allowable speed is used as the base speed.

Operational procedures for typical parts machined on Brown & Sharpe and New Britain Gridley machines are shown in accompanying illustrations.

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TYPICAL USES OF COPPER AND COPPER ALLOYS

Electrolytic Tough Pitch Copper—Gutters, roofing, screening, busbars, conductivity wire, electrical contacts, radio parts, switches, terminals, anodes, nails, rivets, soldering copper, and tacks.

Deoxidized Copper—Gas lines, heater lines and units, oil burner tubes, plumbing pipe and tube, condenser, evaporator and heat exchanger tubes, dairy tubes, distiller tubes, steam and water lines; air, gasoline, hydraulic and oil lines.

Gilding, 95%—Coins, medals, tokens, bullet jackets, firing pin support shells, fuze caps, primers, emblems, jewelry, plaques, base for gold plate and vitreous enamel.

Commercial Bronze, 90%—Etching bronze, grillwork, screen cloth, weatherstripping, compacts, marine hardware, rivets, screws, screw shells, costume jewelry, ornamental strip, screen wire.

Red Brass, 85%—Weatherstrip, conduit, screw shells, electrical sockets, eyelets, fasteners, fire extinguishers, condenser and heat exchanger tubes, flexible hose, pickling crates, plumbing pipe, service lines, traps, badges, compacts, costume jewelry, dials, etched articles.

Low Brass, 80%—Ornamental metal work, medallions, battery caps, bellows, musical instruments, clock dials, flexible hose, pump lines, tokens.

Cartridge Brass, 70%—radiator cores and tanks, reflectors, bead chain, flashlight shells, lamp fixtures, socket shells, screw shells, eyelets, fasteners, pins, rivets, spring tubes, ammunition components.

Yellow Brass—Grillwork, radiator cores, reflectors, electrical socket shells, stencils, plumbing accessories, sink strainers, pins, rivets, screws, springs.

Muntz Metal — Architectural trimming, large nuts and bolts, brazing rod, condenser plates, condenser, evaporator and heat exchanger tubes, hot forgings, valve stems.

Leaded Commercial Bronze—Screws, screw-machine parts, pickling crates.

Low-Leaded Brass (Tube)—Used where some degree of machinability is required, together with modern cold-working properties, plumbing J-bends, pipe, pump lines, trap tubes.

Low-Leaded Brass — Butts, hinges, watch backs.

Medium-Leaded Brass — Butts, gears, nuts, rivets, screws, dials, engravings, instrument plates.

High-Leaded Brass (Tube)—General-purpose screw-machine products.

High-Leaded Brass — Clock plates and nuts, clock and watch backs, clock gears, wheels, channel plate.

Extra-High-Leaded Brass — Clock plates and nuts, clock and watch backs, clock gears and wheels, channel plate.

Free-Cutting Brass—Gears, pinions, automatic high-speed, screw-machine parts.

Leaded Muntz Metal — Condenser tube plates.

Free-Cutting Muntz Metal—Automatic screw-machine products.

Forging Brass—Forgings and pressings of all kinds.

Architectural Bronze—Architectural trim, butts, hinges, lock bodies, forgings.

Admiralty—Condenser, evaporator and heat exchanger tubes, condenser tube plates, distiller tubes, ferrules.

Naval Brass—Aircraft turnbuckle barrels, balls, bolts, marine hardware, nuts, propeller shafts, rivets, structural uses, valve stems, condenser plates, welding rod.

Leaded Naval Brass—Marine hardware, screw-machine products, valve stems.

Manganese Bronze (A)—Clutch discs, pump rods, shafting, balls, valve stems, bodies, welding rods.

Aluminum Brass — Condenser, evaporator and heat exchanger tubes, distiller tubes, ferrules.

Phosphor Bronze, 5% (A)—Bridge bearing plates, bellows, beater bars, clutch disks, cotter pins, diaphragms, fuse clips, fasteners, lock washers, sleeve bushings, springs, switch parts, truss wire, wire brushes, chemical hardware, perforated sheets, textile machinery, welding rods.

Phosphor Bronze, 8% (C)—For identical use as 5% (A), but for more severe service conditions.

Phosphor Bronze, 10% (D)—Heavy bars and plates for severe compression, good wear and corrosion resistance; bridge expansion plates and fittings, and articles requiring extra spring qualities, greatest resiliency, particularly in fatigue.

Phosphor Bronze, 1.25% (E)—Electrical contacts, flexible hose, pole-line hardware.

Cupro-Nickel, 30%—Condensers, condenser plates, distiller tubes, evaporator and heat exchanger tubes, ferrules.

Nickel Silver, 18% (A)—Rivets, screws, table flatware, truss wire, zippers, optical bows, camera parts, core bars, base for silver plate, costume jewelry, etching stock, hollow ware, name plates, radio dials.

Nickel Silver, 18% (B)—Optical goods, springs, resistance wires.

High-Silicon Bronze (A)—Hydraulic pressure lines, bolts, butts, clamps, cotter pins, hinges, marine hardware, nails, nuts, pole-line hardware, screws, hot water tanks, bearing plates, bushings, cable, channels, chemical equipment, heat exchanger tubes, piston rings, screen cloth and wire, propeller shafts (marine).

Low-Silicon Bronze (B)—Hydraulic pressure lines, anchor screws, bolts, cable clamps, cap and machine screws, marine hardware, nuts and rivets.

Standard Temper Designations for Rolled Sheet and Strip

	Nominal Reduction B & S Gage No.	Approx. Percentage Reduction
Quarter Hard	1	10.9
Half Hard	2	20.7
Three-quarter Hard	3	29.4
Hard	4	37.1
Extra Hard	6	50.0
Spring	8	60.5
Extra Spring	10	68.7

How Douglas Stretch-Forms Titanium

395 lb has been saved by replacing stainless steel with titanium in a project at Douglas Aircraft

...Given here is Douglas experience in stretchforming*

COMMERCIALLY PURE titanium has been applied in a project recently undertaken at Douglas Aircraft Company. In this case, weight was extremely critical and titanium, despite its high cost of $20/lb, was the most economical method for saving approximately 5% of the total structural weight.

To fabricate titanium with minimum expense and lost time, Douglas made a number of preliminary tests to develop proper tooling and methods. During production, extremely close control was maintained. As a result, Douglas produced a large number of titanium parts (849 per unit), yet the number of scrapped parts was held to approximately 5%. While Douglas experience in the main closely parallels previously reported practice (*AM*, June 11 '51, p145-153), new data has been developed on stretch forming and on the production of crowned skins.

How to Stretch Shapes

During the project, about 100 "Zee"-section frames were made on the Hufford Stretch press. Stretch blocks were made net with no springback allowance. Kirksite was used for the form-block material. Contours and bevel angles were checked to an adjustable table setup and to the form block.

Frames were of two types. One was of 0.081-in. material with considerable variation in contour, and no return flanges. The second was of 0.040-in. material with fairly constant contour, and a return flange on the compression side.

Fabrication was accomplished in six operations: (1) brake from section; (2) stretch—1st stage; (3) interstage anneal (1300° F, 1 hr); (4) and blast to clean and remove scale; (5) stretch—2nd stage; (6) stress relieve (550° F—2 hrs); (7) check and straighten.

Problems in Stretching

Problems in fabrication fell into six categories:

Section Variations: Dimenisonal variations in the brake-formed sections caused bevel-angle, web-depth, and contour discrepancies. Small longitudinal cracks in the bend radii were successfully stretched and subsequently salvaged by welding.

Stress Concentrations: Defects, large cracks from brake operations, and grip-jaw indentations caused breakage in the stretching operation. Parts which failed away from the block were generally salvageable.

Necking: Parts failed in the stretching operation by necking at areas of high strain. Severe local necking without failure caused loss of flange height. This was avoided by allowing excess material to compensate the loss, and a trim operation was added after forming. In an effort to minimze necking difficulties, parts were stretched cold out of an icebox, but results were inconclusive.

Twist: Frames with high webs twisted badly in the first stage because sufficient pre-stretch could not be employed to offset the tendency to buckle on the inner flange in wrapping without fracturing the outer flange. However, the interstage anneal, second stretch, and subsequent handwork produced satisfactory parts.

Contour Variations: Frames with severe changes in contour generally over-formed. As mold-line contour tolerances of ± 0.010 in. were maintained, all frames were handworked to contour after forming. To set the varying bevel, the outer flange was vibrated while under load. This operation also assisted forming by reducing block friction and by permitting the creep characteristics of the material to work to advantage.

Handwork: Cold handwork caused breakage, and heat could not be employed with the Kirksite blocks. Thus parts had to be hot-formed without the assistance of blocks, except for checking.

Recommended Procedures

(1) Accurate sections prior to stretching should be employed. These could be fabricated by rolling, or power-brake and draw-bench sizing. (2) Sections should have a return flange on the tension side to prevent loss of flange height and to inhibit the necking tendency. (3) Parts should be split so regions of high strain with straight or gradual intermediate contour are avoided. (4) High webs should be avoided on severe contours. A maximum of 10% stretch should be used, assuming neutral axis at the inner flange. (5) Stretch blocks should be made of steel to permit the use of heat in handwork.

Stretched and Crowned Sheet

Stretch forming of skins was limited by lack of excess material required for gripping and the high cost of tooling in relation to the number of parts required. However, experience indicated that: (1) For limited quantity, roll forming and planishing hammer will produce accurate and satisfactory parts. (2) Normal stretch-press practice may be employed provided good quality material is used.

The commercially pure titanium produced by Remington Arms was used throughout. While this material is already considered obsolete by many, the experience gained can be used as a guide in the application of any of the newer alloys by merely taking account of the differences in stress level and permissible strain.

Abstracted from a paper by O. A. Wheelon, production design engineer, Douglas Aircraft Company, Inc. at the SAE National Aeronautic Meeting, Los Angeles, Calif.

Will Defense Production Be Caught in the Squeeze?

When Congress revised and extended the Defense Production Act, it relaxed a squeeze on business profits.

President Truman asserted that this action by Congress cripples the government in its effort to prevent inflation which, as he puts it, could lead to "enrichment and profiteering for the few, economic hardship and misery for the many."

He asked Congress to rescind its action.

This editorial—the second on problems presented by "escalator"clauses—aims to throw some light on this conflict of opinion.

The Squeeze

The squeeze on profits was imposed in the name of price stabilization. The idea behind it was simple. The *selling prices* of industrial products were to be held under a tight lid. But many industrial costs are affected by "escalator" clauses of one kind or another which tend to boost production *costs*. Thus, with rising costs and fixed prices, profits would be squeezed and much of the cost of defense would thereby be shifted from those favored by escalator clauses to business concerns.

The mechanics of this squeeze on profits were complicated. But here, in brief, is how it was to work. The first step was to require manufacturers to set ceiling prices, effective May 28, for their products.

These ceiling or maximum prices were to allow for increases in manufacturers' costs that had occurred since Korea. *But they did not allow for all increases.* Manufacturers, for example, could not include increases in indirect costs—office or selling costs. Neither could they, in calculating their new prices, include increases in the costs of materials or direct labor that had come after March 15. This was the first phase of the squeeze on profits.

The second phase was prepared by **not** putting a ceiling on costs. The Wage Stabilization Board said it could not disturb the operation of "escalator" clauses by which wage rates are geared to the cost of living. Moreover, nothing could be done to curb the operation of the farmers' "escalator" clause, the farm parity arrangement. Under it, the federal government underwrites higher prices for farm products to match increases in the cost of things farmers buy. So this left wages and many materials costs free to rise against a ceiling imposed on the prices of what industry has to sell.

Relief—at a Loss

On two conditions only would the Office of Price Stabilization permit a company to raise its prices and escape this squeeze. One of these was that increased costs had more than wiped out its profits; in other words, that it was operating at a loss. The other condition was

that the industry of which the company is a part was not, as a whole, making "excess profits." That is, the industry, as a whole, could not get price relief if its overall profits before taxes were greater than 85 percent of its average profits during the best three of the four years from 1946 through 1949. Many companies expected that their profits would be cut drastically before they could get through this narrow escape hatch.

When this squeeze on profits was set up, we were told that industry as a whole was reporting record profits. But, it was equally true that wage rates and farm prices also were at record high levels. And it was also true that, under the impact of rising taxes and the dislocations caused by the defense mobilization program, profits actually were on the way down.

Profits — Going Down

By the time Congress acted to relax the squeeze, corporate profits, after taxes, were running at a rate 20 percent lower than they had been six months before. And the clear prospect was that they would continue to decline.

So the issue put up to Congress was simply this. Should business firms stand so much of the brunt of the defense costs while "escalator" clauses continued to exempt organized workers and farmers from paying their share of those costs?

But this question actually is much broader than one of fairness or unfairness alone. One certain effect of such a squeeze on profits would be to undercut the capacity of private industry to install the new plants and equipment needed for our mobilization effort. Today — unlike World War II — private industry is financing almost all of our huge program to expand production. And about two-thirds of the money that has been plowed into the expansion and improvement of our industrial machine since World War II has come out of profits.

In view of all this, Congress decided last summer to relax the pressure on profits. This was done by the controversial Capehart Amendment to the Defense Production Act. This amendment has serious administrative weaknesses. But some measure with the same purpose is needed to maintain profits at a high enough level to finance the huge and continuing expansion of our industrial machine that is now underway.

Basic Issues

As soon as the amendment was enacted, the President asked Congress to revise the law again. The heart of his proposal was to restore to the Administration the powers it used last spring to arrange the squeeze on profits outlined here.

This controversy will continue. There can be no final answer to it as long as we have the economic controls made necessary by mobilization.

But if we look beneath the surface of this technically complicated controversy, we shall see clearly that the basic issues are:

1. Whether we really shall make an effort to distribute fairly the burdens of inflation caused by our defense mobilization —

2. Whether farmers and organized workers should be exempted from these sacrifices by escalator clauses — at the expense of the nation as a whole —

3. Whether profits should be squeezed still more — at the risk of putting a fatal squeeze on the effort of industry to build new plants and install new tools. These new facilities are essential to maintaining American living standards — and they are the heart of our ability to defend ourselves and the rest of the free world.

Americans face no more important economic issues at this time.

McGraw-Hill Publishing Company, Inc.

ROUND TABLE

Alias John Smith

"Say, Ed, I need help—if you can keep your mouth shut about it. Quite a juicy bit of gossip, if it gets out. And it would only cause a good man trouble."

"Well! Sounds like a woman is mixed up in this somewhere. All right, I won't say a word, Al. What's the dope?"

"You know Hester, the miller hand? Well, his name isn't Hester at all—it's Morrison."

"That's easy. All you have to do is to tell Personnel about it. That's their worry—if it is one—not yours."

"It isn't as easy as that, Ed. Hester has been here now almost two years, and he's done a good job. He changed his name when he came here—domestic troubles."

"How did you find all this out? You been snooping, Al, or did he confess all to you? And how do you know he's telling the truth?"

"He's telling the truth, all right; I've checked on that. I put on a new man last week, from out of town. He recognized Hester—called him Morrison, and Hester was obviously quite put out. So I talked to both men—one at a time, of course. Hester's name *was* Morrison. He worked in a garage in his home town. Married the wrong gal—she made his life Hell and started running around with other men. So he just disappeared."

"Leaving her with no money and the kids, no doubt. Are you sure that's all it was—maybe he was beating some kind of a rap."

"No, not according to Nabor, the new man. He says Morrison was a good guy, and everybody around their small town was making cracks about his wife. There weren't any kids, no debts, and his wife has the house and a job. He never was on Social Security anyhow, so there's no angle there."

"I still think it's a job for Personnel, not for you. Let them decide whether it's all right, Al."

"How can I? They'll just start an investigation and trot out the crying towels. Hester has done a good job; he's not afoul of the law, and he hasn't done anything there to cause any trouble. I say his business is his own, as long as it doesn't affect the shop."

"Look, Al, a guy can't just vanish like that, at least in the USA. If he sneaks out on one bad situation, he'll sneak out on another—and this time you'll be among the bag holders. It's only self-protection to turn him in."

"If that's all it is, his name is Hester to me—and forget I mentioned it, Ed."

ARE A MAN'S PAST *and his identity his own—as long as he offends no criminal law? Does a shop executive who keeps the man's confidence take a chance? Your ideas on this subject will interest others. Discussions of earlier topics appear on later pages.*

Can you improve

YOUR PERSONNEL RECRUITING?

With the "help problem" again difficult, there is greater need for efficient recruiting. The personnel agency is a widely used source of new employees that can, and usually does, provide many services often overlooked by management...

- ***HOW DO YOU SELECT AN AGENCY?***
- ***WHAT SERVICES DOES THE AGENCY OFFER?***
- ***HOW CAN YOU HELP THE AGENCY HELP YOU?***

BY JOHN D. WHITMORE, Executive Secretary
THE LONG ISLAND ASSOCIATION, GARDEN CITY, N. Y.

MOST businesses have used personnel agencies at one time or another, but many firms are not familiar with all of the help available from such agencies. Proper use of these agencies will save time and money, as well as increase the opportunities for locating more suitable personnel.

Employment agencies usually provide services comparable to those of an advertising agency, with the agency performing many of these services for employers without charge. In most states, agency compensation is provided by the employee placed, at rates fixed by law.

Some employers feel that their employees should not have to pay for employment, or that employees will go to companies that provide their own employment office, thus avoiding the fee. Under such conditions, the employer will often pay the fee or, when many recruits are needed, will contract for the services of an agency. One novel method is to allow the new employee to pay the usual fee, then, after six months of satisfactory service, return the money to him as a bonus. This protects the employer at the initial stage and provides a morale-booster for the employee when he has made the grade.

Almost every major company has an advertising agency under regular contract. Very few have recognized that by selecting a proper personnel agency and working closely with it, the business man will eliminate many problems regularly associated with his personnel work, while gaining many advantages available through no other source.

Most personnel agencies keep an active file of applicants properly screened and interviewed. This, in many cases, will fill needs for office workers, as well as skilled, semi-skilled, and technically trained workers. There is also the advantage of obtaining first-hand knowledge of available executives and highly trained specialists direct from agency files.

When necessary, agencies advertise in newspapers and business publications for applicants to fill vacancies listed with them. This is at the agencies' expense. All screening of applicants, classification, and in some cases preliminary testing, is done by the agency. These services are performed without charge or at extremely modest fees. Most agencies are staffed with experienced interviewers, capable of following specifications, and judging which of the applicants is best suited to the purpose.

More famous agencies are usually in large cities. The current trend to decentralize industry has attracted an increasing number of agencies to suburban areas. Usually business firms will find a local agency preferable. The local agency is more familiar with local labor-market conditions, actual wage rates, availability of workers—plus the character, background, and quality of applicants.

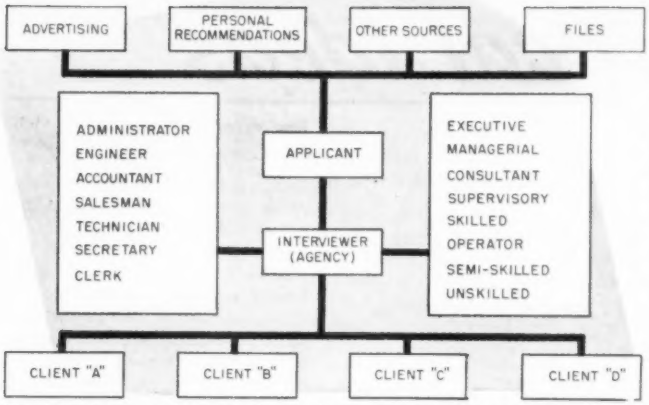
In cases where exceptionally experienced specialists may be desired, it may be necessary to seek the aid of agencies which specialize in that field. Never make the mistake of feeling that your needs are so peculiar to your business that only you or your personnel director can qualify job applicants. Employment agencies must produce better than satisfactory results for many employers, or they cannot remain in business. Successful placement of job applicants to meet exacting requirements, and who prove to be good employees, determines the agencies' ability to survive.

Selecting an Agency

Firms presently using agency service usually list satisfactory service as the most important reason for selecting one agency over another. Regardless of your past experience, the following qualifications may be of service in analyzing either the agency now used or one which is contemplated.

1. Agency history, including: How long in business? Kind of personnel specialized in? How many employees in the agency? Experience and training of agency employees?

2. Agency's current business status, as determined by: Average number of job applicants per week? Jobs applicants seek; the most common sought? Average



An efficient agency draws applicants from many sources on a scope much wider than that available to most individual firms. Personnel unsuited to one client's requirements may fit exactly another client's need. At an individual plant the application would be told, "Sorry, nothing open today"

number of placements? Experience the agency has had in your, or allied fields? The attitude of other agency clients to the agency?

3. Techniques used by the agency to attract applicants, such as: volume of advertising and media used, direct - mail campaigns, word-of-mouth results, and participation in civic affairs, chamber of commerce, and trade groups?

4. The character of the establishment: Tidy offices, with adequate facilities to handle your needs. Interviewers and receptionists well-groomed and courteous; who appear to take a genuine interest in applicants, and a management suitable for servicing your needs.

Upon choosing the agency, the interviewer should be furnished adequate information concerning the company and factors that affect the job. As the agency is required to fill your specifications with regard to the applicant, it is also obligated to inform the applicant of all the conditions relating to the job. An applicant unwilling to accept a certain condition of employment is wasting the time of both himself and the interviewer if the condition is not apparent until the interview has been completed.

Here is what the agency must know:

1. Expected duration of job.
2. Hours
   a. Scheduled
   b. Amount of overtime, if any
3. Salary
   a. Range of rate
   b. Expected hiring rate
   c. Special benefits
4. Working conditions
5. Future possibilities

FOR BEST RESULTS

1. Give as much advance notice of opening as possible.
2. List position with only one or two agencies in one territory.
3. Refrain from independently advertising a position listed with an agency.
4. Give complete specifications of job.
5. List all conditions of employment.
6. Give a courteous interview with as little delay as possible.
7. Inform applicant immediately if he does not qualify.
8. Notify agency of reasons for non-acceptance.
9. Notify the agency of disposition of job.

Most agencies will welcome questions regarding their practices and policies. Many have prepared literature describing their organization as well as their services. In almost every agency operation certain economic and social factors influence functions and activities. These include: type of businesses and trades predominant in the area, quality and stability of local residents, standards of living, circulation characteristics of advertising media used, and general knowledge of the agency.

Agency size is rarely important as an influence upon its success in serving clients. Small agencies frequently prove superior to large. However, there are occasions wherein the size and scope of the agency must be considered; for example, the staffing of a large manufacturing firm moving into a new area. An activity of this size will probably require special arrangements for handling a large volume of applicants, and work, within a limited amount of time. On occasions such as this, employers should make arrangements for their needs in sufficient time to include adequate planning. Usually the planning is a matter of properly informing those who will be working on the case with full details about personnel required, and providing adequate facilities required to serve the occasion. The importance of giving your agency proper information is equally vital regardless of the number of openings to be filled.

In addition to the job description, the following personal specifications should be provided for the interviewer:

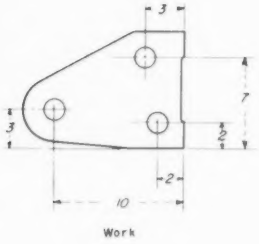
Experience Desired: length, type, quality.

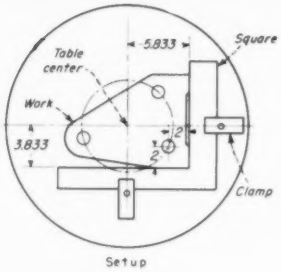
Education Desired: public school, technical school, college, special training.

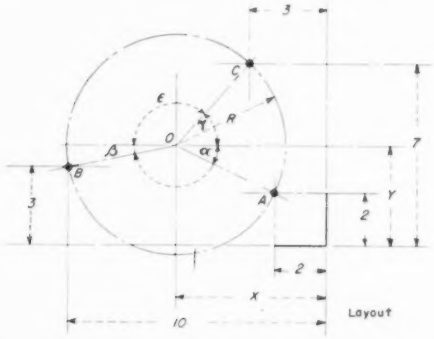
Personal: age, health, physical requirements, marital status, personality, male or female, appearance.

With the great demand upon management by federal regulations, stepping up of defense activities, and the need for greater reductions in costs than ever before, business firms will find the personnel agency of valuable assistance. Much of the cost of recruiting employees and handling applicants can be avoided through proper use of a reliable agency. Experienced agency clients have, in many instances, found this method of handling their recruiting problems of sufficient value to warrant their assuming all fees and costs.

Practical Ideas







Circle Method Locates Three Holes

WHEN THE ILLUSTRATED WORK was ready to be drilled and reamed in our jig borer, I found the borer already piled high with work. Luckily I remembered the fact that any three holes can be located on a circle; and also that the jig-boring circular table, with an accuracy of ± 4 sec, was not in use.

With a little mathematics, I found all the dimensions necessary to locate the three holes on a given circle. Using trigonometry, I found the center in the middle of the three holes, found the exact radius (4.29 in.), and scribed the circle. A square was clamped on the table to locate the center between the holes over the center of the table, and the table was located under a rigid drilling spindle.

By rotating the table through the angles found with mathematics, the work was positioned so the holes could be drilled exactly in the right spots.

Finding the center of the circle, and its radius, is done this way: Assume A, B, and C are the centers of the three holes desired, and they are all located from a given reference point on the work.

$AO = BO$, then $(x-2)^2 + (y-2)^2 = (10-x)^2 + (y-3)^2$

$16x + 2y = 101$

$BO = CO$, then $(10-x)^2 + (y-3)^2 = (x-3)^2 + (7-y)^2$

$14x - 8y = 51$

Adding the above, $x = 5.8333$

Subtracting, $y = 3.83333$

$$\text{Radius} = \sqrt{(x-2)^2 + (y-2)^2} = 4.2492$$

$$\text{Angle alpha} = \frac{y-2}{x-2} = 25^\circ\ 33'\ 36''$$

$$\text{Angle beta} = \frac{y-3}{10-x} = 11^\circ\ 18'\ 36'$$

$$\text{Angle gamma} = \frac{7-y}{x-3} = 48^\circ\ 10'\ 47''$$

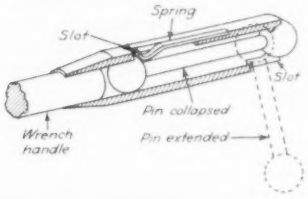
With these known, figuring the angular rotation of the table for driling is simple. *A. Vetsch, Steffisburgh, Switzerland.*

Tap Wrench Altered For Convenience

TOOLMAKERS can fit tap wrenches so leverage pins will slip in and out of the shank, as needed.

The original handle of the wrench is cut off, then a piece of tubing is silver-soldered on. One slot is cut in the side of the tube to admit a spring which is soldered into position. This spring holds the ball end of the pin down toward the wrench end of the tool when the pin is not used.

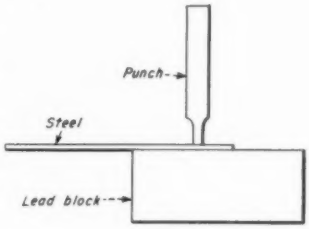
The tube must be relieved inside to allow for a shoulder at the end. The shoulder confines the end of the pin, preventing it from becoming disassembled. A second slot is made at the end of the tool to clear the shank of the pin. *P. L. Bernardi, Detroit, Mich.*

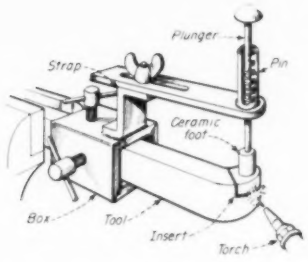


Punching Spring Steel

THIS METHOD is used for punching holes in spring-steel parts with practically 100% success.

The steel is placed on a lead or lead-alloy block. A punch is made to the exact shape of hole required, with the sides ground straight and the bottom face exactly square with the sides. A heavy hammer blow will pierce stock as thick as 0.040 in., producing a clean hole. *G. D. Carlsen, Manhattan Beach, Calif.*





Spring Push Rod Grips Carbide Tips

WHEN A SHOP prefers to braze its own carbide tips onto tools, the job is usually a one-man one; but the one man needs four arms to handle the tool, tip, brazing torch, and silver solder at the same time. A good way to set up such a job is to utilize a push rod that will hold the new tip firmly against the tool, which is held in a vise.

An angle-iron box fitted with setscrews is clamped to the tool-shank after the tool is gripped in the vise. To the box is welded a bent strap, and to this is clamped the push-rod assembly, which is simply a spring-loaded plunger working in a cylinder with notched slots down its side in which a pin through the rod is caught for easy adjustment.

After the tool has been notched and cleaned and the tip has been cleaned, they are assembled with a strip of solder and flux and the push rod is tightened. At first, gentle push-rod pressure is applied; but when the solder is melted, the rod is tightened to exclude all air from the joint. *M. Polak, Huddersfield, England.*

Weighted Wheelhead Improves Grinding Quality

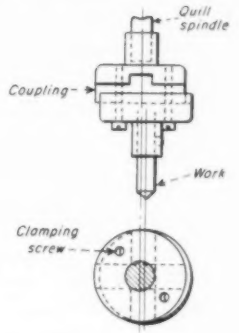
PRODUCING A HIGH FINISH on 4-by-¼-in. steel pins was a recent problem in our shop. Due to machine vibration, we were getting a slight ripple when the pins were finished on our centerless grinder.

Our solution was to place a scrapped forging die, weighing 400 lb, on the top of the wheelhead. This dampened the vibrations sufficiently to allow a fine mirror finish to be produced on the pins. *F. E. Harris, Toronto, Ont.*

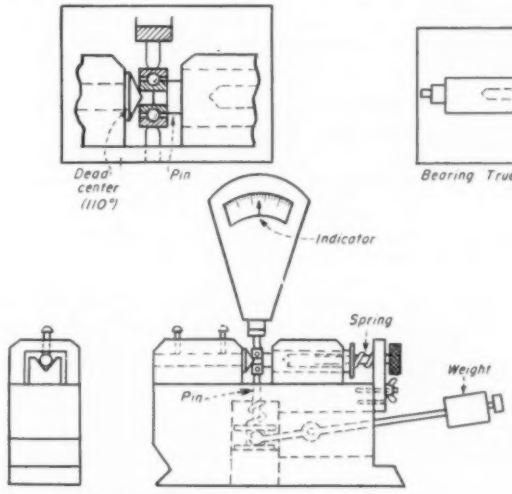
Centering Work With Couplings

WHEN GRINDING small conical bodies, it was found that small inaccuracies caused by the collet or chuck caused eccentricities that could not be compensated for. But a small Oldham coupling could be held in the grinding quill and adapted to hold the work.

The coupling was attached directly to the high-speed spindle, and an adapter collar was made to screw to the coupling. This collar held the work by means of a setscrew.



Slight eccentric adjustments were then possible to center the work exactly. *Paul Grodzinski, London, England.*

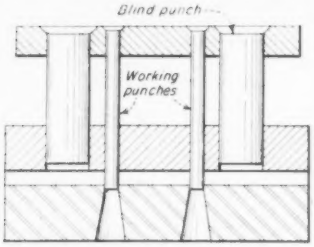


Radial-Play Checker Inspects Ball Bearings

SMALL BEARINGS, in the range from 1/8 in. to 5/16 in. (OD), are inspected with a special instrument that was made in our shop. Used with a Scherr Comparitol, it checks end play in conventional single-row bearings.

A fixed dead center in the headstock and a bearing truing pin made to fit each size in the tailstock of the device hold the inner race of the bearing solidly while the outer race is checked for play. A spring-loading arrangement in the tailstock forces the bearing truing pin against the inner race to hold it against the center.

Under the bearing, a weighted lever raises a spring-loaded pin to press up against the outer race. This motion, if there is any, is transmitted to the scale of the comparing machine. *R. H. Carter, Keene, N. H.*



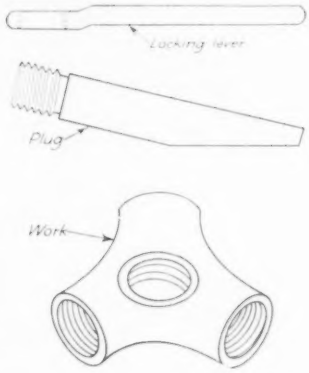
Blind Punches Brace Weak Ones

THIN PIERCING PUNCHES, located in diesets that require a fair amount of clearance or daylight, can be supported to prevent snapping when side pressure is accidentally exerted by adding short, blind punches that operate in the die, but do not actually touch the stock. Like guide posts, such punches steady the die set. They can be made of drill rod to work with a sliding fit in holes in the stripper. *Federico Strasser, Santiago de Chile.*

Angle Workholder Locates Y Fittings

This simple fixture solved the problem of drilling and tapping a number of Y-shaped fittings, and can also be applied to other parts having holes arranged radially around a central hole. It is made from a bar of square, cold-rolled steel; with one end turned and threaded to fit the central hole in the work. The other end is beveled off to suit the angle of inclination of the radial holes, and is clamped to the drillpress table.

A locking lever is tapped to fit the threaded plug and is screwed down on it. For drilling, the work is screwed on the plug, indexed around to the desired position, and locked by turning the locking lever. The only limitation of the fixture is that the centerlines of the holes must meet at the center of the central hole. *C. L. Martin, Lennoxville, Que.*

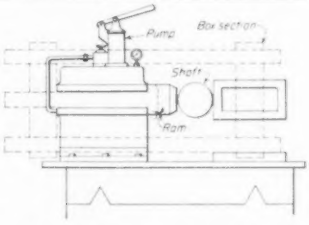


Axle Straightener Works On Top of Lathe

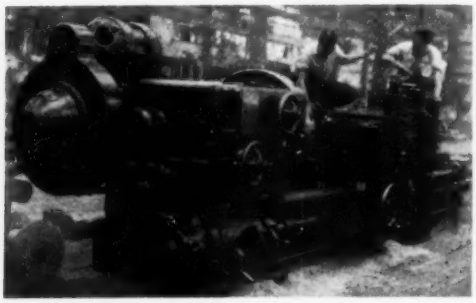
BENT AXLES, connecting rods, and other large shafts are straightened on a lathe equipped with an old hydraulic pump. We have used the rig even for 6½-in.-dia axles, and without damaging the lathe in any way.

Although the pump and cylinder are mounted on the carriage, and the work is supported between the pump and a backrest mounted on the rear slide, the lathe structure takes no stress because of a box-section structure built up between and around the cylinder and back rest. The structure is made of steel slats, slotted and drilled to nest together, forming a sturdy frame for the compressive action of the pump.

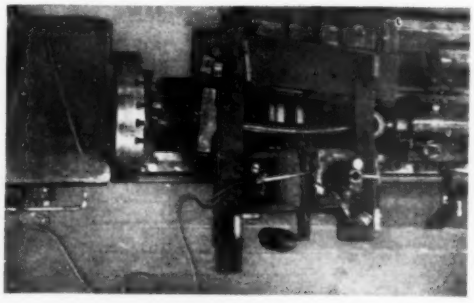
Work is located against the backrest, rotated so the bend is outermost toward the cylinder, and the cylinder is advanced. Pumping exerts a compressive stress on the work to straighten it.



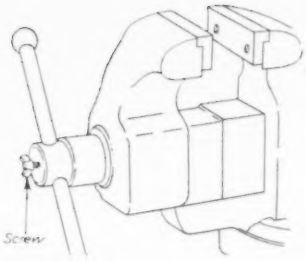
The framework is provided with pins and holes so it can be adjusted to take odd-shaped workpieces, locating the center of the bend opposite the cylinder even when the curve is not regular. *Justo P. Ramirez, Tocopilla, Chile.*



Heavy lathe is utilized for straightening axles, not because of strength, but because of large, straight bed



Strong box frame is located between headstock and tailstock, confining cylinder, backrest, and bent work



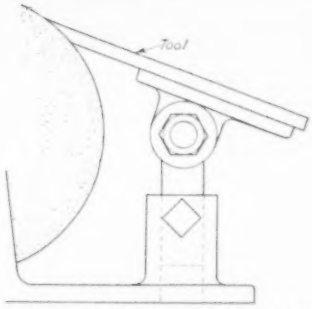
Vise-Handle Clamp Holds Handle Balanced

WHEN LARGE, but relatively fragile, objects must be held in a vise the weight of the vise handle when it is off center may be enough to damage the work. To prevent this, a small hole can be drilled and tapped in the spindle knob, and a small setscrew assembled. This allows centering the handle. *Thomas Trail, Catonsville, Md.*

Swivel Holder Speeds Toolbit Grinding

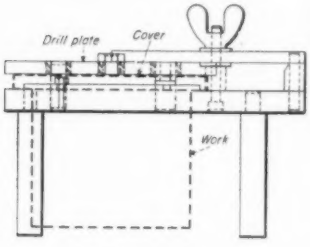
CONSIDERABLE TIME can be saved when you lap the front edges of tools to produce a smooth, hollow-ground surface if a fixture is added to a grinding wheel.

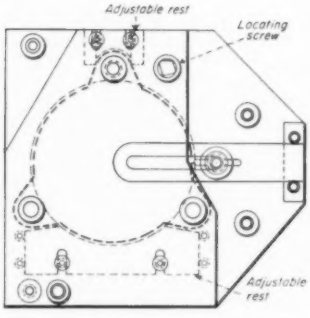
The fixture is a swiveling plate on the end of a post that fits into a bushing on the grinder. Both the setscrew that clamps the post at a given height and the lock-spring-equipped swivel bolt allow adjustment. *Martin H. Ball, Watervliet, N.Y.*



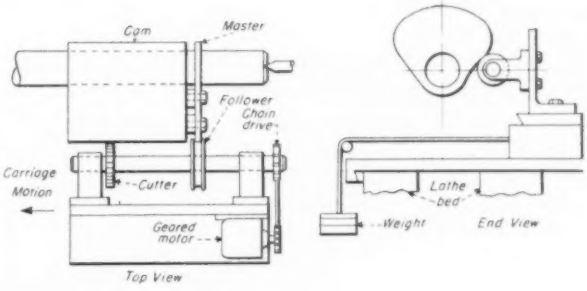
Drill Jig Matches Case and Cover

CASTINGS ARE OFTEN rougher than they should be these days, which often means that matching pieces are difficult to fit together. For a case and cover set we had to drill to produce matching holes, we made a jig that would take both parts; thereby insuring a good match every time. *Anthony Gabriele, Floral Park, N. Y.*





Large Cams Milled On Twin-Shaft Lathe

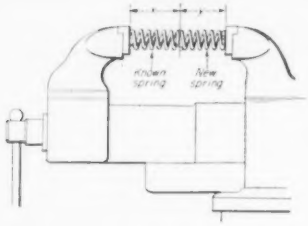


A NUMBER OF LARGE ROLLER CAMS had to be machined to the shape illustrated, but were too large to be finish-cut on any existing machinery. After they had been roughed out to within 1/16 in. of shape on a planer, they were set up on a lathe with special attachments.

In place of the toolpost and top slide we mounted a stout angle plate. This carried two large bearing blocks, and was equipped with a geared motor. The blocks supported a cutter arbor and milling cutter keyed and locked in place. A cam follower, cut to the same OD as the cutter, was slipped on the arbor without a key so it could slide along the arbor to maintain contact with the master disk when the carriage was moved.

A mandrel was mounted between centers on the lathe, and this supported the work. At one end of the work, the master was bolted into position to guide the follower disk. The disk was made with flanges on both sides so it would always be in contact with the master disk.

The geared motor drove the cutter arbor through a chain drive and sprocket keyed to the arbor. As the carriage was traversed, the work was rotated slowly (1 rpm), and the motor drove the cutter at a reasonable speed (3/32 in. per rev). Because of a chain and weight attached to the rear of the slide, constant contact was maintained between the work and cutter. *M. C. Hussey, Bristol, England.*



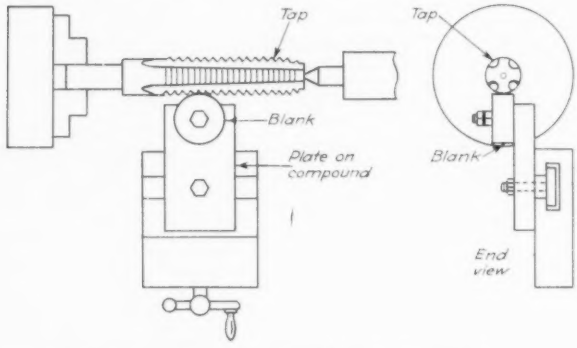
Vise Pressure Indicates Spring Strength

PHYSICAL PROPERTIES of springs can be easily found by formula, but when you're trying to match a given spring and don't know what it's made of, the only way you can match it is by trial.

By compressing two springs together in a vise—as illustrated—you can compare your old spring with a new one. If distances x and y are equal, and the number of turns are the same in both springs, the springs have the same strength.

If x and y are not equal, but are proportional to the numbers of turns in each spring—and this should be checked by varying the amount of compression of the vise—then the springs still have the same strength per turn.

If no proportion or equality works out, the springs are different in properties, and cannot be matched without calculations. *P. Fracarossi and P. Redl, Buenos Aires, Argentina.*



Tap Cuts Worm Gears In Lathe

SMALL WORM-GEAR reduction units for light duty can be easily produced with a simple fixture on a lathe, using a tap as a hob. The tap is chucked or held between centers and driven by a dog, and the gear blank is mounted on a vertical spindle set up on a plate on the slide.

The stud that pivots the blank should be a running fit with little play in the hole in the blank, and the threads should be long enough to take two nuts so they can be jammed.

Slow rotation of the tap is enough to cut the work, and to start it rotating slowly to produce the required teeth all around the gear. One revolution extra should be allowed for a finishing cut on the gear. It is important to have the gear blank a little thicker than the clearance flutes in the tap so one tooth will start cutting before the last one clears out of the work.

Calculating the gear-blank diameter so incorrect lead or overcutting will not result is done this way:

Using a $\frac{3}{4}$-10 tap, for example, each revolution of the tap will represent 0.100 in. of circumferential travel of the blank. If a ratio of 25: 1 is required, multiply 25 by 0.100 to get 2.5 in.—the blank circumference.

A worm to match the gear can be made from a piece of ordinary stock, thread-turned to the same shape and pitch as the tap. *Frank Biechele, Brooklyn, N.Y.*

$25 *In addition to regular payment*

for the best

PRACTICAL IDEA

An extra payment of $25 will be made for the best Practical Idea in each number of *American Machinist*. To avoid bias, the selection will be made by readers, a different group each time.

PAYMENT—$25 in addition to regular rates for the item as published, to be paid as soon as reader votes are received—usually three to four weeks after the date of the issue. The winner will also be announced in these pages as soon thereafter as practicable.

JUDGES — A group of 200 *American Machinist* readers is asked to select preferred articles in each issue. The group is a true cross-section of all readers, and changes entirely each time. Their votes, in addition to guiding the editors, select the best Practical Idea. If at any time their votes result in tie, $25 will be paid to each and every co-winner. Decision of the readers will be final in each case.

REQUIREMENTS—Only items in the Practical Ideas pages are eligible, and they must be submitted directly by the originator. Do not worry about your shortcomings as a draftsman, photographer or author—every item will be edited in accordance with *American Machinist* standards, and suitable illustrative or explanatory material added where needed. Readers will judge only the finished product—in terms of its usefulness to them.

WHO MAY ENTER—Anyone may enter except employees of the McGraw-Hill Publishing Co., Inc., and those of advertising agencies or departments. Suggest to your employees that they submit ideas.

HOW TO ENTER—Send your entry to "Practical Ideas Editor," American Machinist, 330 West 42d St., New York 18, N.Y.

135th Winner:

(For August 20 issue)

Clarence B. Winch

Dividing a Circle

Twice as much
Usable Scale Length
with a

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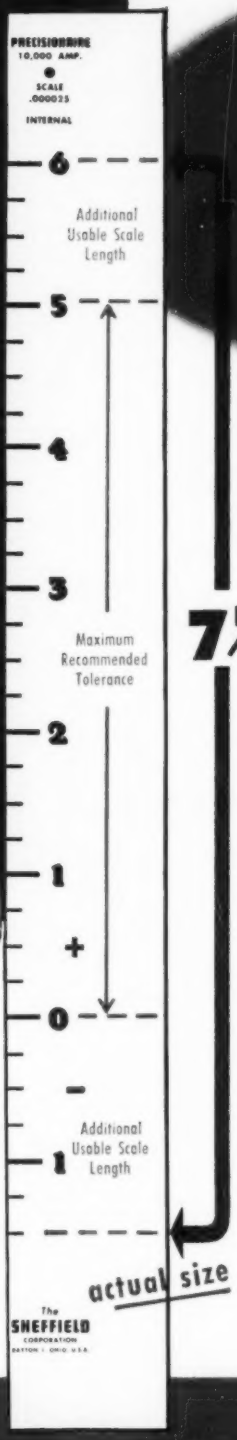

MODEL NUMBER	MAXIMUM RECOMMENDED TOLERANCE	MINIMUM USABLE SCALE LENGTH BEYOND TOLERANCE LIMITS
1,000	.005	.0025
2,000	.0025	.0013
5,000	.001	.0005
10,000	.0005	.00025
20,000	.00025	.000125

7½ inches of usable scale length—*more than twice as much as most other air gages.*

MANY MORE CLASSIFICATIONS—more selections can be made because of the extra scale length—manufacturing tolerances can be widened to save time and cost without sacrificing quality.

SHOWS *HOW MUCH* PARTS ARE OUT—especially advantageous where parts are coming consistently on the borderline or just outside tolerance limits.

BETTER FOR BRINGING TO SIZE—Readings can be taken earlier when approaching size so that the operator is sure of not going beyond tolerance, in fact, he can accurately work to desired limits *within* the tolerance zone.

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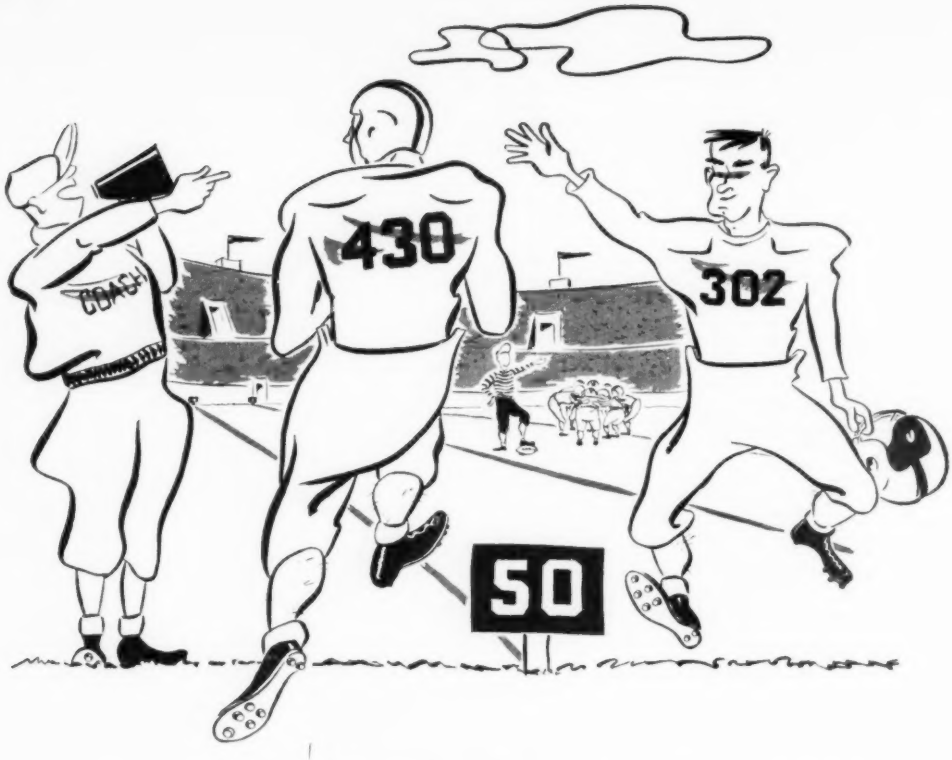


Can Type 430 Substitute for Type 302?

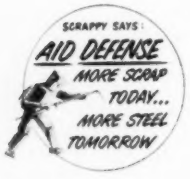
Government restrictions are taking the popular 18-8 chromium-nickel stainless steels "out of the game" for many non-defense uses.

In selecting an alternate stainless steel for their products, many designers have turned to Armco 17 (Type 430)—a chromium grade.

To help you determine whether or not Type 430 is suitable for your products, we have just published a new folder listing satisfactory and unsatisfactory uses. Ask your nearest Armco Distributor for a copy.

In fabrication, Type 430 is not as ductile as Type 302. However, with slight changes in practice, many difficult forming and drawing operations can be performed on the chromium grade. Where welding is involved, Armco Type 430 Ti (a titanium modification) provides much more ductile welds than regular Type 430.

These and other fabricating problems are covered in detail in another new Armco bulletin, "How to Fabricate Type 430 Stainless Steel." Your nearby Armco Distributor will be glad to give you a copy.



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ARMCO

American Machinist

The Angles to Milling . . . 1

By Prof. M. F. Spotts, Northwestern University. Taken from a paper presented to the Fall Meeting, ASME.

TRIAL AND ERROR is ordinarily used to orient an inclined plane of a workpiece in the proper position on a machine tool. This process is wasteful of time and often results in spoiled work. Here are some simple mathematical methods for calculating the angles required to rotate the inclined plane into the horizontal:

In Fig. 1, assume that the inclined plane $P_1P_2P_3$ must be properly located for machining by rotating the body into the horizontal. Furthermore, suppose that surrounding material obstructs any overrun of the cutter or grinding wheel across line P_1P_2. This line must, therefore, be made parallel to the ways. It is only necessary that the location of the plane in space be known, and for this it is assumed that the Cartesian coordinates for any three points of the plane are obtainable. The locations of the sides of the work, with respect to the three points, P_1, P_2, P_3, or their projections, O_1, O_2, O_3, will also be known. It will, therefore, be necessary to deal only with solid $P_1P_2P_3O_1O_2O_3$ in Fig. 1.

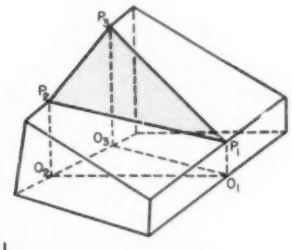


FIG. 1
Workpiece with surface $P_1P_2P_3$ to be machined

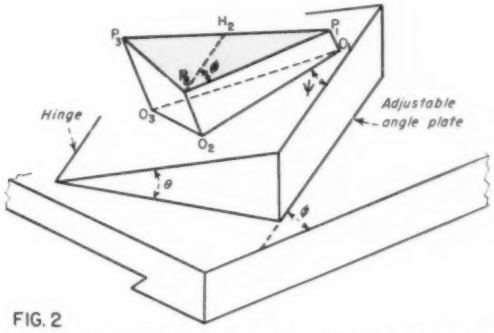


FIG. 2
Workpiece mounted on milling machine preparatory to machining

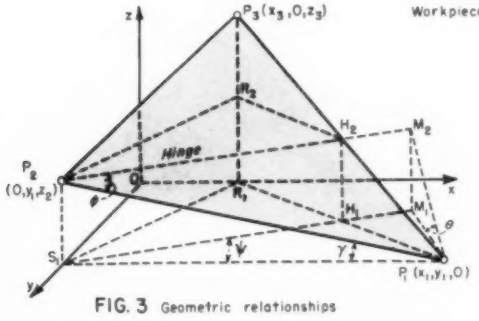


FIG. 3 Geometric relationships

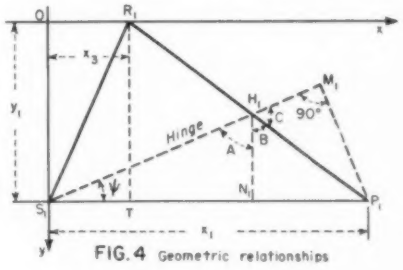
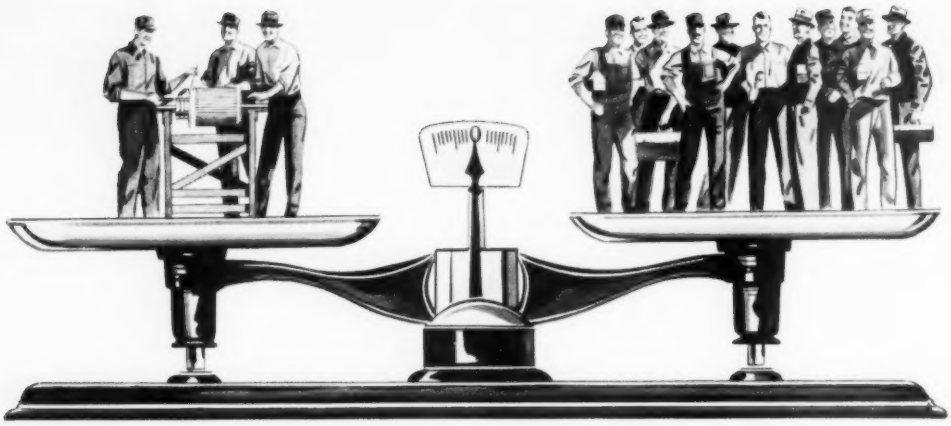


FIG. 4 Geometric relationships



$370 INVESTED IN SILICONE INSULATION SAVES $80,000 IN MAN-HOURS ALONE

TRAVELLING CRANE MOTORS insulated with Class B materials had a normal life expectancy of only 20 days in a large southern foundry. At least 2½ to 3 hours were required to change motors. Down-time cost $1000 an hour in lost man-hours or $2500 for each failure. That amounts to over $40,000 a year in lost man-hours alone.

OVER TWO YEARS AGO, three crane motors, rated at 15, 30 and 50 hp, were rewound with Silicone (Class H) materials at an additional cost of about $370.00. Still in service, those Class H motors have already saved $80,000 in labor plus the cost of rewinding with Class B materials plus the value of lost production.

THAT'S TYPICAL of the performance of motors protected with Class H insulation made with Dow Corning silicones. They last at least 10 times longer than the next best class of motors. They also have at least 10 times as much wet insulation resistance. That's why more and more military and industrial engineers are demanding Class H equipment. That's why more and more design engineers are specifying Class H equipment. And that's why Class H is becoming more readily available from motor manufacturers and rewind shops.

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The Angles to Milling . . . 2

Suppose the work is to be done on a milling machine or planer equipped with an adjustable angle plate. Fig. 2 shows the work in position with plane $P_1P_2P_3$ horizontal, and line P_1P_2 parallel to the ways of the machine. This figure shows the following angles to be determined; ϕ, angle between hinge and ways; Θ, inclination of the angle plate; and Ψ, angle between hinge and side O_1O_2.

The coordinates for P_1, P_2, P_3 can be taken so that P_1 lies in the xy-plane, P_2 lies in the yz-plane, and P_3 lies in the zx-plane and so that side O_1O_2 is taken parallel to the x-axis.

Line P_2H_2 is the intersection of a horizontal plane at elevation z_2 with plane $P_1P_2P_3$. Rotation about P_2H_2 will bring $P_1P_2P_3$ into the horizontal; line P_1H_1 is parallel to the hinge of the angle plate and is accordingly marked "hinge" in Fig. 3.

Angle ϕ is the angle between P_1H_1 and P_1P_2, since these lines are respectively parallel to the hinge and to the ways. Angle $M_1P_1M_1$ or Θ is the angle required to bring $P_1P_2P_3$ into the horizontal; hence, it is equal to the inclination of the angle plate. Angle Ψ is the angle between P_1S_1, or side O_1O_2, and the projection of the hinge, S_1H_1.

Fig. 4 shows the xy-plane of Fig. 3. As the locations of points P_1, S_1, and R_1 are known (because the coordinates of P_1, P_2, and P_3 are known) the various lengths on this figure can be computed by trigonometry. Angle Ψ can be found from:

$$(1)\quad \tan \Psi = \frac{N_1H_1}{N_1S_1}$$

From Fig. 3, for Θ:

$$(2)\quad \tan \Theta = \frac{z_2}{M_1P_1}$$

Angle γ which is needed in subsequent calculations is given by:

$$(3)\quad \tan \gamma = \frac{z_2}{x_1}$$

Consider tetrahedron $S_1M_1M_2P_2P_1$ in Fig. 3:

$$(4)\quad P_2M_2 = S_1M_1 = P_1S_1 \cos \Psi$$

$$(5)\quad P_2P_1 = \frac{P_1S_1}{\cos \gamma}$$

$$(6)\quad \cos \phi = \frac{P_2M_2}{P_2P_1}$$

Substituting equations (4) and (5) in (6) we get:

$$\cos \phi = \frac{P_1S_1 \cos \Psi}{\frac{P_1S_1}{\cos \gamma}}$$

$$(7)\quad \text{therefore } \cos \phi = \cos \Psi \cos \gamma$$

Example: Let x, y, and z coordinates for the three points be as follows: $P_1(7.78,\ 4.32,\ 0)$, $P_2(0,\ 4.32,\ 1.65)$, $P_3(1.97,\ 0,\ 3.36)$. Find the values of angles ϕ, Θ, and Ψ.

Solution — By elementary trigonometry, using both Fig. 3 and 4 we find N_1H_1, N_1S_1, and P_1M_1. The following are the steps needed without substituting in the numbers.

To find N_1H_1:

From Fig. 4

$$(8)\quad (R_1P_1)^2 = y_1^2 + (x_1 - x_3)^2$$

From Fig. 3, for similar triangles $P_2R_1P_1$ and $H_2H_1P_1$

$$(9)\quad \frac{H_1P_1}{R_1P_1} = \frac{H_2H_1}{P_2R_1} = \frac{z_2}{z_3}$$

$$(10)\quad H_1P_1 = \frac{z_2R_1P_1}{z_3}$$

From Fig. 4, for similar triangles R_1TP_1 and and $H_1N_1P_1$

$$(11)\quad \frac{N_1H_1}{R_1T} = \frac{H_1P_1}{P_1R_1} \quad R_1T = y_1$$

$$(12)\quad N_1H_1 = y_1\frac{H_1P_1}{P_1R_1}$$

Substituting from equation (10) for H_1P_1

$$N_1H_1 = \frac{Z_2}{Z_3}y_1$$

To find N_1S_1

$$(N_1P_1)^2 = (H_1P_1)^2 - (N_1H_1)^2$$

$$\text{then } N_1S_1 = x_1 - N_1P_1$$

To find M_1P_1

$$\tan A = \frac{N_1S_1}{N_1H_1}$$

$$\text{Tan } B = \frac{N_1P_1}{N_1H_1}$$

$$C = 180^\circ - B - A$$

$$\sin C = \frac{M_1P_1}{H_1P_1}$$

$$M_1P_1 = H_1P_1 \sin M_1H_1P_1$$

By solving these equations it is found that $N_1H_1 = 2.12143$ in., $N_1S_1 = 4.92687$ in., and $M_1P_1 = 3.07683$ in. Hence:

In equation (1), $\tan \Psi =$

$$\frac{N_1H_1}{N_1S_1} = \frac{2.12143}{4.92687} = 0.4305837 \text{ in.}$$

$$\Psi = 23.2959^\circ$$

In equation (2) $\tan \Theta =$

$$\frac{z_2}{M_1P_1} = \frac{1.65}{3.07683} = 0.5362662 \text{ in.}$$

$$\Theta\ 28.2031^\circ$$

In equation (3) $\tan \gamma = \frac{z_2}{x_1} = \frac{1.65}{7.78}$

$= 0.2120823$ in.

$$\gamma = 11.9740^\circ$$

In equation (1) $\cos \phi = \cos \Psi$ $\cos \gamma = 0.9184747 \times 0.9782418 = 0.8984903$

$\phi = 26.0397^\circ$

Other solutions for rotating the plane can be found using Analytical Geometry or Euler's Angles.

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In the competition for industry's lubrication business, all refiners are constantly improving their products. Every so often, one company or another finds a way to make a petroleum product that, for a particular use, licks to a standstill anything its competitors can offer. Immediately the others dig in and try to find the secret. Until they succeed, the originator's ingenuity pays off in a rising flood of sales.

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Want to see factual case histories and learn more about this product? Send for illustrated booklet, "Sunoco Way Lubricant." Samples are available, too, to companies in the metalworking industry. Write Dept. 10-AM.

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9 Ways to Save Stainless Steel

Courtesy the Committee of Stainless Steel Producers of the American Iron & Steel Institute

TO SAVE stainless steel through cooperative design and planning, ask yourself these questions:

1. Can we safely use a chromium stainless in place of a chromium-nickel type?

Much more readily available today, chromium types are somewhat more difficult to fabricate, a little more susceptible to pitting and local corrosive attack, and require extra care in cleaning. When substituting, seek competent metallurgical advice.

2. Have we used the smallest practical gage and poundage?

Yield and breaking strengths of stainless steels are 50% higher than those of mild steel. Don't use more than you need. Remember, too, that no allowance for loss of strength through corrosion is required.

3. Have we taken care of direct joints between stainless steel and other materials?

Direct metal-to-metal contact between different metals may accelerate corrosion of one metal or the other. Wood and other porous materials absorb process materials and slowly build up high concentrations of corrodents. In the restricted, oxygen-poor area of a joint, and especially under partially corroded rubber or fiber gaskets, active corrosion may proceed apace. Gaskets or packings containing graphitic materials accelerate such action. Specify, instead, synthetic products containing asbestos. Use asphaltum or zinc-chromate paints to separate stainless steel and wood.

4. Have we designed away all places where foreign matter might lodge?

Avoid crevices, sharp interior corners, and small internal radii. Make smooth corners with large-radius bends where possible. Fillet sharp inside corners with weld metal if necessary. Keep seams to a minimum. If seams are crimped, riveted or spot-welded, fill with weld metal or solder. Grind all welds or solder deposits smooth, then polish.

5. Have we provided ready means for reaching all internal surfaces during cleaning?

The key to maximum service from stainless steel is regular cleaning. It will be done more consistently if workmen find it easy to reach all parts of the equipment during cleaning operations.

6. Have we provided for easy removal of filters, screens, valves, and other hard-to-clean accessories?

7. Have we specified the most economical finish to clean?

The higher the finish, the greater the resistance to corrosion and the easier the cleaning. All surfaces should be finished to the highest degree that is economically feasible.

8. Do we make sure that surfaces are protected during fabrication or repair?

Surface may be protected from weld spatter, grinding abrasives, and accidental scratches by gummed heavy protective paper, plastic protective films, or even gluing newspaper to the steel with wallpaper paste. Soldering flux should be scrubbed off thoroughly.

9. Are we ordering the size of stock which most closely matches finish dimensions?

Is layout planned to minimize waste, and are measurements and marks checked before cutting or forming?

Production News

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Today, right now, you can take the first step toward startling production gains in your own shop. The free book, offered below, gives you the facts about Lusol, the metal-working solution which is revolutionizing coolant practices and machining procedures. You'll learn how plant after plant, all over the country, has stepped up output from nearly every machine in its shop. Actual case histories of 50%, 200% and even 500% increases in machine speeds and production rates!

Lusol replaces soluble oils and emulsions, as well as regular cutting oils on many operations.

NEW TYPE COOLANT—The simple, factual evidence in this book shows *why* Lusol cools faster, increases tool life, reduces the number of grinding wheel dressings. You'll see how Lusol, an oil-free concentrate added to water, makes the best coolant you ever used. How it makes water wetter, so it removes heat faster. How it decreases the surface tension of water, so it penetrates to the very cutting edges of your tools and keeps grinding wheels from loading up.

You'll learn the extra advantages possible with oilless Lusol. Advantages like elimination of degreasing before painting or assembly. How floors and workers' clothes stay cleaner. No oil-soaked shoes. How Lusol licks machine odors and dermatitis. And how it protects machines and products from rust.

SAVINGS IMPRESSIVE—Truly, these are savings so important and far-reaching that no one who owns or operates a machine tool can afford to pass them up. So today take time to ask for your copy of the 20-page book, "Lusol, the all-chemical metal-working solution."

Over 40,000,000 Gallons of LUSOL SOLUTION USED TO DATE

In plants all over the nation, in almost every type of metal-working operation, over 40,000,000 gallons of Lusol solution have been used, boosting production rates, saving tools and lengthening grinding wheel life.

In each of these applications Lusol has replaced another coolant, showing substantial savings. Obviously, an enormous amount of technical know-how has been accumulated during these conversion periods. This data is constantly sent to Lusol sales engineers in the field. Your local Lusol sales engineer, listed in the classified phone book under "cutting oils," is well equipped to answer your questions.

users say*

case histories of Lusol at work

A BEARING MAKER—"Look at that fine finish! No smoke around the machine, and the bearing-ball comes off the broach so cool it can be gauged for accuracy immediately."

•

A JOB SHOP—"41 drills and 25 taps were required for producing 1,984 pieces in 50 hours. Changed to Lusol and produced more pieces in same period with 12 drills and 8 taps."

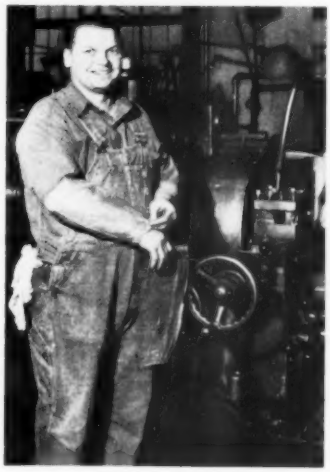
•

A MOLDING MANUFACTURER—"Lusol keeps the machines clean; a distinct advantage over the lubricant we formerly used. The men like Lusol because they can see the work clearly, right up to the time the metal enters the rolls."

•

A MACHINE TOOL BUILDER—"We remove 245 cubic inches of cast iron per hour in that surface grinder. Instead of 17 wheel dressings per chuck load formerly required, only 7 are needed now with Lusol. We're going 100% to Lusol."

*User names furnished on request.



LUSOL proves mild and non-irritating to workers' hands

The cleansing action of Lusol, together with its super-wetting properties, sometimes prompts questions about dermatitis. "How does such an efficient metal-working solution affect workers' hands?" It doesn't!

The case of the man shown above is typical of Lusol's performance in actual shop conditions. Sulfurized cutting oil, formerly employed, so irritated this man's forearms that he had to wear the plastic sleeves you see in the photograph. With Lusol in his machine, he has discarded the sleeves; has no skin trouble at all.

FREE BOOK

Get complete facts about Lusol by writing for this 20-page booklet. It contains information on machine cleaning, maintenance of Lusol solutions, elimination of dermatitis and odor in machines, plus many case histories of Lusol at work. Write F. E. Anderson Oil Company, 215F, Portland, Conn.

TALKING SHOP

Babes in the Wood

WOMEN OPERATORS in a large automatic-lathe department objected violently to the sulfur and hydrogen-sulfide odors of the sulfurized cutting oil. The oil-company specialist provided samples of deodorized oil in three essences: vanilla (really vanillin), pine, and violets. The ladies sniffed and voted. They turned down the specialist's preference—vanilla, and his guess at their preferance—violets. The pine essence was their choice, because it reminded them of the pine forests—which do not exist within some hundreds of miles of the plant.

What Price PR

THE 4 I's, an organization of industrialists in the Mahoning Valley centered around Youngstown, O., is now starting a new idea. Convinced that a well-rounded public relations program is helpful, not only to the company but to the community as a whole, 4 I is questionnairing its members to find out what programs they have. Then a jury will select which public relations program is poorest, and the 4 I's will finance a well-rounded program for that company, including employees' magazine, bulletin boards, letters to the employees' families, and so on. Public and employee attitudes will be measured at the beginning and end of the program.

Shell-Molding Pluses

IF OUR SHORT ITEM on shell molding in Oct. 15 *AM* interested you, here are a few additional points: In automotive plants, the process has been found to cut machining 75 to 90% on some parts . . . Only a grinding cut may be needed to finish the part; surface is excellent as the piece comes from the mold . . . The problem of removing fins and scabs, as encountered with conventional castings, is avoided . . . On artillery ammunition, a grind on the bourrelet and one on the ID at the nose completes the projectile, and fragmentation is excellent.

Peanuts, Chewing Gum, and "Cokes"

THE ANGLO-AMERICAN COUNCIL on Productivity has just issued its longest report, "The Brass Foundry", a 200-page document with 170 illustrations. The report indicates that American brassfounding is *not* highly mechanized and is behind British technical standards. But U. S. output per manhour is far ahead because of American incentive systems. The U. S. foundryman pays 7 hr work for a pair of shoes, the British 15; the American pays 3 days' work for a suit, the British 3 weeks.

The report details many evidences of small-scale mechanization and streamlining to increase production, then goes on to remark on U. S. emphasis on guards and safety devices and campaigns. Further, the productivity team was surprised at the quality of our changing and washing facilities—and the lack of canteens. Says the report: "Americans want no tea-breaks during the day and only half-an-hour for lunch. 'Why waste production time,' they argue, 'When it is worth money to us?' Instead of canteens, slot machines are provided, supplying peanuts, chewing gum, candy, etc., and most popular of all, that national American drink, Coca-Cola."

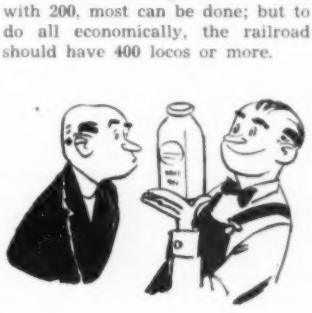
Whirlaway

HIGH ROTATIVE SPEEDS necessary to attain the desirable 5000 to 6000 sfpm with small grinding points, are obtainable both by high-frequency electric motors and by air turbines. Bryant is currently using the former method on internal-grinding heads that can be adjusted by dial to speeds from 60,000 to 200,000 rpm. Springfield Machine Tool obtained about 300,000 rpm several years ago with an experimental air turbine. In the latter case, special air-film sleeve bearings were used, some of the turbine air being pulled off to provide the film, which is less than 0.001 in. thick.

This may be one answer to the problem of bearings at high speeds. As speed increases, the shaft takes on familiar characteristics of a gyro, rotating about its own center of gravity and resisting outside influences. An extremely precise antifriction bearing may thus prove too accurate for the job, the balls may be driven clear of the inner race, or the retainer may be overheated despite addition of cooling fins.

Loco Break Points

BECAUSE of complex machine-tool equipment required for modern diesels, one locomotive supplier calculates a railroad with fewer than 25 engines should have others do all overhaul. With 50 locomotives, some reconditioning can be done; with 200, most can be done; but to do all economically, the railroad should have 400 locos or more.



Decal on Bottles

RECENTLY, when Springfield Machine Tool Co. used a milk bottle as a pattern to produce a forging die in a contour-following lathe, the finished die not only showed contours of the bottle, but also reproduced the lettering on the surfaces, which had been applied by a Decalcomania. Thickness of the decal letters was estimated at somewhere between 0.002 and 0.003 in. Meanwhile, we have had reports of a French lathe of similar type, which is claimed to be able to pick up variations of 0.0005.

News of Metalworking

BENDIX GETS HUGE ORDER—The largest order of its kind yet placed by the Royal Australian Air Force, worth several million dollars, has gone to Bendix Aviation Corp. of U.S. and its Australian partners for American-patented aircraft electrical equipment.

20,000 TRUCKS ORDERED—Van Doorne's Automobile Factories of Eindhoven, established only a year ago, has obtained a Dutch government order for nearly 20,000 army trucks for a total of 160 million guilders ($45 million).

CAR PRICED AT $625—A Spanish company will be formed to manufacture the "Capi," a 529-lb car to sell for about $625. The two-passenger car has a 2½-hp engine, is expected to do 47 mph on the flat, at 75 miles per gal.

Aircraft Production 6 Months Behind; Airframes Ahead of Engine Output

WASHINGTON — Aircraft production is running close to six months behind schedule. Meanwhile the aircraft industry is caught between expansion demands from Pentagon and the cutting knife of Charles E. Wilson's DPA.

Pentagon wants a rapid build-up to 140 wings. Joint Chiefs say this is the rock bottom security requirement needed by mid-1953.

On the other hand, Mr. Wilson sees another danger threatening. A fattening of current military production schedules is liable to result in widespread inflation. He's in favor of the aircraft build-up, but wants to tag it onto present schedules—draw out production to, say, 1955.

• **Aircraft manufacturers figure** that they got only 70% of metals they asked for in third and fourth quarters of this year. Such cuts call for a slash in civilian goods, Air Force believes, urging this production program: (1) Cut consumer goods to the bone; (2) Build up aircraft production capacity quickly to get the 140 wings in the air; (3) Drop back to a low production level with a fair modernization program; (4) At the same time go back to civilian production.

It can't be done, Mr. Wilson says: The impact would be too tough on the economy. Besides, chief bottleneck right now is jet engines, because of a shortage of thermal alloy steels. A cut in consumer usage of CMP metals wouldn't yield any more such steels.

If you can't get any more jet-engine production right away, DPA concludes, then peg airframe output to engines and hope for the best. That means another cutback for aircraft because airframes have been outproducing engines.

CPR-80 Puts Ceiling on Used Machine Tools

WASHINGTON—All sales of used machine tools and extras have been placed under a new separate ceiling price regulation known as CPR-80, issued and effective Oct. 13. The ceilings apply to used machine tools "as is," rebuilt or reconditioned.

The new prices, shown in the accompanying table, are based on list prices of manufacturers on Jan. 25, 1951, for the most comparable new machine tools and extras.

• **Each sale of a rebuilt machine** must be accompanied by a guarantee certificate. The guarantee (for 30 days) is that the machine (or extra) "has been dismantled and all worn or broken parts replaced; all worn surfaces have been properly machined and scraped; and the machine has been tested under power with proper instruments and these tests show the same tolerance as that of the used machine when new."

CPR-80 defines a "reconditioned" used machine tool as one on which these operations have been performed: all worn or broken parts that affect the operation have been replaced; all rust and scale have been removed; the machine has been properly cleaned and painted; the machine has been tested to show that it performs satisfactorily. All this must be certified in writing.

• **Age of a used machine** is determined by the builder's serial number stamped on it. If it does not have a serial number, it will be presumed to have been made before Jan. 1, 1916, unless physical proof of age can be established.

Ceiling prices are on an f.o.b. basis, except "as is" machines, which are sold wherever located.

With each sale, the seller must furnish the purchaser with this information: (1) Seller's name and address and date of sale; (2) description of each used machine tool sold; 3) selling price; (4) charge made for taxes, special packing, or credit; (5) description of new machine tool selected as most comparable new machine, including price on Jan. 25, 1951.

Used Machine-Tool Price Table

	"Rebuilt guaranteed"	"Reconditioned"	"As Is"
	(percentage of new machine-tool price)		
Manufactured after Jan. 1, 1948	95%	85%	75%
Manufactured after Jan. 1, 1936	90%	75%	60%
Manufactured after Jan. 1, 1928	85%	70%	50%
Manufactured after Jan. 1, 1922	70%	50%	30%
Manufactured after Jan. 1, 1916	60%	40%	20%
Manufactured before Jan. 1, 1916	50%	30%	15%

Tool & Die Makers

WASHINGTON — Tool and die manufacturers have protested as "unrealistic, unwarranted and unstabilizing" the Wage & Stabilization Board's recommendation that "ceiling rates" for tool and die makers be set up in 23 major production areas of the country in an attempt to curb pirating and job-hopping in the industry.

These rates, WSB explained, would be from 30 cents to 50 cents higher than average wages now being paid. Different ceiling rates would be set for job shops and for captive shops.

• **Employers would have to abide** by existing regulations for making increases, but they could not pierce the ceiling rate for these workers. The ceilings would be reconsidered every six months in the light of cost-of-living changes.

Persons earning wages above the ceilings—called "red circle" rates—could continue to receive them, but

How to Lower Production Costs Studied at SAE Aircraft Forum

LOS ANGELES — Costs keynoted production-forum sessions on new materials, methods, and equipment at the Society of Automotive Engineers aeronautical meeting Oct. 3-6.

• **Titanium got star billing** in discussions of metals. There was much optimism for the metal despite its high cost and the difficulty of working it.

Titanium boosters pointed out that while the metal costs $12 lb now, aluminum likewise was expensive at first—$20 lb.

Solar Aircraft Co. advised manufacturers machining stainless steel to use as heavy a tool as possible to dissipate heat, to apply a great deal of coolant, and give special attention to cutting tools. Solar reports improving tool life 50% by vapor blasting and liquid honing.

• **A definite trend** in the aircraft industry to avoid machining high temperature alloys was reported. The industry is turning more and more to precision forming, casting, and molding, and to precision belt grinding to form accurate contours.

Carbon tetrachloride is being added to cutting oils and flushes to speed removal of austenitic steel chips. But it's expensive. It costs $5000 to vent and exhaust a machine to protect the operator from carbon-tet fumes.

High-temperature alloys, such as Inconel-X, are easily machinable if they are partially heat-treated first, said a panel member. Parts are heated up to 2150 F long enough to get uniform heat; then they are quenched. The part is machined and then given final heat-treat, being heated to 1600 F and held at that temperature for 16-24 hours.

Machining of integrally stiffened wing panels, which was supposed to be an interim step until forging and extrusion methods were perfected, will be around a long time, says Lockheed Aircraft Corp. Forging of parts is still a long way off. But extrusion and rolling methods of making the parts are coming along very well. Lockheed says it may soon extrude large panels and finish them by machining.

Protest WSB's Wage Recommendations

they could get no further increase and could keep the above-ceiling rate only as long as they remain with the same employer. No employer could hire above the "ceiling rate" and in most cases his legal hiring rate would be below that.

WSB feels that in six or eight months, wages for tool and die makers in an area would level off at the ceiling rate, thus eliminating any future incentive for job-hopping.

• **Major objections** to the proposal are that the trend of wages up to the ceiling rates will be accelerated because of the existing targets.

Automobile and other "captive" employers fear that the higher differential in wages paid by job shops will be further widened because of their greater freedom to grant increases under WSB regulations. This will result in such a disparity that the pensions and other long-term benefits enjoyed by those in the captive shops will be disregarded as the workers go for the higher pay.

George S. Eaton, executive secretary of the National Tool & Die Manufacturers Association, which represents over 500 contract shops, declared that the area rates would have serious inflationary and unstabilizing effects throughout the entire metalworking field.

Requests from industry witnesses for area rates were based fundamentally on using current regional wage surveys and providing adequate manpower controls. Neither of these recommendations was followed, Mr. Eaton asserted.

• **These are the ceiling rates** suggested by the study committee, with the job shop rate listed first and captive shop rate second:

$2.85 and $2.60—Detroit and Toledo.

$2.75 and $2.60—Chicago.

$2.65 and $2.65 (same)—San Francisco Bay area.

$2.65 and $2.50—Cleveland, Dayton, Kansas City, Los Angeles, Milwaukee, Newark, New York, Philadelphia, San Diego, St. Louis, and East St. Louis.

$2.60 and $2.50—Buffalo and Niagara Frontier area Minneapolis-St. Paul, and Rochester.

$2.55 and $2.45—Cincinnati and Indianapolis.

$2.50 and $2.40—Boston, Worcester, Bridgeport, Bristol, Hartford, lower Connecticut valley, Providence and Syracuse.

Herbert L. Tigges

H. L. Tigges Leaves NPA, Returns to Baker Bros.

WASHINGTON—Herbert L. Tigges has returned to his duties as executive vice president of Baker Brothers, Inc., Toledo, Ohio, after having served since late in June as director of the Metalworking Equipment Div. of the National Production Authority. He has given unstintingly of his time to the national defense program since 1948.

In that year he was appointed consultant on machine tools to the National Security Resources Board. He organized, with the aid of Brig.-Gen. Stewart E. Reimel and Capt. E. A. Henning, and was chairman of the Joint Industry Mobilization Group of the machine tool industry. This group was assigned the task of planning an organizational set-up for handling in Washington the machine tool problem in a national emergency. This set-up then was brought into existence in skeleton form. Later this group became known as the Joint Industry Machine Tool Preparedness Reserve Group. It helped work out the so-called Phantom Orders program, which became the basis for the present pool contract plan.

After Korea, Mr. Tigges became a consultant to NPA on machine tools, spending several days a week in Washington. In June he became director of the Metalworking Equipment Div. He is a past national president of the American Society of Tool Engineers. He also has been active in the National Machine Tool Builders' Association.

IT'S MOVING DAY...

• **Independent Pneumatic Tool Co.** Aurora, Ill., has moved its Thor Cincinnati branch to a new building at 3726-28 Floral Ave.

• **Neomatic, Inc.,** manufacturer of electronics components, has moved to larger quarters at 11632 San Vicente Blvd., Los Angeles.

• **Pratt & Whitney Div.,** Niles-Bement-Pond Co., West Hartford, Conn., has relocated its Detroit office in a new building at 8626 West McNichols Road, Detroit.

• **Babcock & Wilcox Tube Co.** has moved its Beaver Falls, Pa., local district sales headquarters from the plant to new office facilities at 712 Eleventh St. The company's Pacific Coast office has moved to the Lawson-Chipman Bldg., 1111 Wilshire Blvd., Los Angeles.

• **E. W. Bliss Co.** has transferred its Chicago office from 919 North Michigan Ave. to 2135 South Austin Blvd.

• **Stedfast & Roulston, Inc.,** machinery distributor, has moved to new offices at 11 Deerfield St., Kenmore Square Section of Boston.

• **Hy-Pro Tool Co.** subsidiary of Continental Screw Co., has moved to its own new building on grounds adjacent to the parent company in New Bedford, Mass.

• **Fuller Tool Co.** has moved to a new two-story plant at 4000 West Eleven Mile Road, Berkley, Mich.

• **Mechanical Air Controls, Inc.** recently moved to a new plant at 15311 West Eleven Mile Road, Royal Oak, Mich.

NOVEMBER MEETINGS

Oct. 31-Nov. 1-2—Industrial Management Society, annual time & motion study clinic; Sheraton Hotel, Chicago.

Nov. 1-4—National Tool & Die Manufacturers Assn. annual convention; Statler Hotel, St. Louis, Mo.

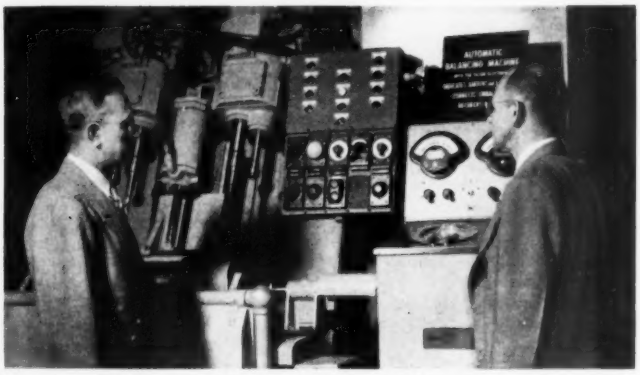
Nov. 8-9—American Management Assn. national production conference; Palmer House, Chicago.

Nov. 7-9—American Society of Body Engineers, annual technical convention; Rackham Memorial Bldg., Detroit.

Nov. 14-16—National Metal Trades Assn. annual convention; The Blackstone, Chicago.

Nov. 14-16—American Institute of Electrical Engineers, machine-tool industry conference; Rockford, Ill. (Contact B. T. Anderson, c/o Sundstrand Machine Tool Co., Rockford.)

Nov. 26-30—American Society of Mechanical Engineers, annual meeting; Chalfonte-Haddon Hotel, Atlantic City, N.J.



Automatic balancing machine exhibited at National Metal Exhibition gets a checkover by Walter A. Sitko, buyer for Ford Motor Co., and W. P. Haines, service engineer of Tinius Olsen Testing Machine Co.

Metal-Show Highlights Point Up Plenty of Progress

DETROIT—Technical sessions pulled a better-than-expected attendance at the 1951 National Metal Exposition, as did the whole show. Total exhibit attendance was about 40,000 with large numbers from the West Coast.

• **The show started** with an announcement by General Electric's Carboloy Div. of a new sintered alloy of carbide—chrome carbide. The alloy, called Series 600, is a combination of chromium and carbon with lead as a binder and almost no tungsten or cobalt. It is as hard as tungensten carbide and as wear resistant, but is lighter in weight, more easily machined, and is highly corrosion-resistant. Production of the metal will start soon, and data is now available for engineering purposes. Expected applications are wear pads, valve balls, centrifuge blades, and other locations where hardness but lighter weight than tungsten carbide is indicated.

Carboloy also announced technical data available—but no production as yet—on titanium carbide (for high-temperature work). Tungsten carbide in rod stock suitable for welding and hard-facing jobs was announced. Tests of this new product indicate 80% of the wear resistance of pure tungsten carbide, but with the added advantage of a ductile core of steel. No production yet.

Handy & Harman demonstrated its silver-alloy brazing rings on a continuous-fed, gas-fired Youngberg Bros machine. Fixtures to hold strainers for droppable aircraft fuel tanks ride on a continuous slat carrier, rotating between two banks of burners. The rig allows a completely open view of the brazing progress and instant inspection of the joints.

• **A Die-tryout press** with 48 by 25 by 20-in. opening was shown by Dake Engine Co. Press is double-acting, with hydraulic cylinder operated by air or electric motor.

Picker X-Ray Corp. had on hand a 24-million-volt betatron for industrial non-destructive inspection—the largest such equipment built commercially in quantity. Sections up to 24-in. thick can be checked with the unit mounted on a bridge crane.

Richard Brothers demonstrated a die set-feeder combination in a punch press that pierces, forms, and blanks strip stock and inserts clinch nuts in a mechanical bond. Also illustrated were interchangeable punches held by spring-loaded ball locks.

• **An electrostatic spray-painting** setup, enamelling washing-machine bodies that were carried by rotating fixtures on an overhead continuous conveyor, was operated by Ransburg Electro-Coating Corp.

Firth-Sterling Steel & Carbide Corp. installed its Method-X drilling

High-speed sensitive drillpress is examined by C. L. Lane, vice-president and general manager, Walker-Turner Div. of Kearney & Trecker Co. and F. J. Trecker, president of Kearney & Trecker

Method-X machine is studied by K. D. Mann, president of Firth-Sterling Steel & Carbide Corp.; M. L. Swars, master mechanic at Aeroproducts Div., and H. T. Walther, Inland Mfg. Div., General Motors

setup, demonstrating the process in cutting round, hex, and gear-outline holes in carbides.

Walker-Turner Div. of Kearney & Trecker had a high-speed, 15-in. sensitive drillpress with spindle speeds from 9,000 to 14,000 rpms, taking 0.006- to ¼-in. drills in a special collet chuck. A bench model has an adjustable tilting table with a head- or table-elevating attachment.

Atlas Press Co. showed off an Atlas-Clausing 18-in. floorstand general-purpose drill with 5 ball bearings in the spindle, a 63/64-in. spindle dia, and 6½-in. spindle travel to accommodate quick-release chucks.

Boice Crane Co. had an improved 15-in. sensitive drillpress with enlarged quill, bearings, and better locking clamps.

• **A display of titanium carbide** for heat-resisting applications was set up by Kennametal, Inc. A working model had a suspended rod under 10,000 psi load, with heating equipment cycling the temperature from 300 F to 1800 F every minute.

The Diversey Corp. showed its alkaline aluminum-etching material for finishing aluminum to an etched or matted finish.

Production Machine Co. had a set-up of No. 914 centerless grinding and finishing machine, equipped with abrasive belts. The equipment takes work up to 6 in. in dia.

Charles Bruning Co. demonstrated a new copyflex model 20 that handles drawings 46-in. wide at 95 ipm.

Aronson Machine Co. showed a new welding-positioner (model 21) with a powered, gear-driven raising and lowering arrangement, as well as powered rotation of the work.

S & S Machinery Co. imported Minganti turret lathes and jig borers, Caser turret lathes, Induma mills, Berardi drilling machines, and other Italian machine tools, on which quick delivery is claimed.

Miller-Taylor Tool Co. featured a new fire-resistant hydraulic system on its Cast-Master machines.

• **A Lodac mechanical press feeder,** operating a pair of gripping arms from a pedestal in front of a punch press, was introduced by Magnaflux Corp. One two-finger arm is hand-loaded with a partly drawn cup, then locates it over the die and drops it. After the press stroke, the other arm grips the drawn cup, raises and shifts it to the left, and drops it into a tote box. Features: safety and fast operation.

Warner Div. of Clinton Machine Co. demonstrated its Thomas-Metal-Master disintegrator, Model A52, for the normal disintegrator jobs, plus cutting special shapes in carbides.

Tinius Olsen Testing Machine Co. broke out a new automatic balancing machine for automotive crankshafts and the like, which measures amount and location of unbalance on two linear meters, then drills out the required weight to balance the work.

Commander Mfg. Co. introduced a multi-angle drill unit with built-in hydraulic cylinder and 4-in. stroke. The body is drilled, tapped, and bossed for mounting it to an angle plate or other fixture.

• **A new automatic welding positioner** for shielded-arc work on strip or round parts was shown by Mix-O-Col Alloy Co. Unit has an automatic welding head, adjustable feed rolls, and can be run with any high-frequency unit.

Standard Electrical Tool Company demonstrated its twin-wheel tool grinders featuring joint or independent head operation and controlled coolant flow.

Drever Co. showed an operating model of its vertical-slot furnace, where split collared rods lower the work through the heating zone.

• **An "Electron" drill** for cutting internal and external shapes in carbide and other hard materials was introduced by Elox Corp. An electrode of the same shape as the desired hole or outline throws minute liquid-quenched sparks to the work, eroding a hole only slightly larger than the electrode.

E. F. Houghton & Co. announced a rubber-impregnated leather packing with high strength, heat resistance, and flexibility to replace wax-impregnated leather packings where high pressures squeeze wax out.

American Wheelabrator & Equipment Corp, demonstrated Model 43 Liquamatte wet-blasting machine using fine-mesh abrasives to hold tolerances within 0.0001 in.

Manufacturers Processing Co. exhibited a vapor degreaser with a vibrating (Syntron) feed that provides good agitation and dryer parts.

Industrial Expansion Notes

• **Pax Metal Corp.**, independent producer of aluminum extrusions on the West Coast, will construct a new plant in Van Nuys, Calif., using the latest equipment, made expressly for the project by Hydropress of New York. In addition to the press machinery, the plant will contain a billet pre-heat furnace, and aluminum-aging and solution heat-treating furnaces.

• **Westinghouse Electric Corp.**, Pittsburgh, will undertake a $296 million expansion program extending beyond 1953. Major projects already undertaken are: a new plant in Raritan Township, N. J. for the production of electronic equipment; a small motor plant at Union City, Ind.; electronic tube plants at Elmira and Bath, N. Y.; an aircraft-armament plant at Baltimore, Md.; a jet-engine parts plant at Columbus, Ohio; and expanded plant for generator output at E. Pittsburgh, Pa.; five new lamp plants; and the purchase of a plastics plant at Hampton, S. C.

• **Worthington Pump & Machinery Co.** will spend $500,000 in modernizing its Oil City, Pa. plant.

Armament Advances Revealed At Ordnance Association Meeting

CINCINNATI—Rockets of twice the performance of those used in World War II are being produced today, Commander W. H. Keighley, head Rockets Section, Research & Development Div., Navy Bureau of Ordnance, told members of the American Ordnance Association at their annual meeting here Oct. 4.

Present trend in metal parts construction of rockets is toward lightness and precision and away from the water pipe and pipe cap methods. Aluminum is being used in the rocket's motor tube, but plastics and Fiberglas are being studied as alternates.

• **Rockets designed for firing** from aircraft range in size from 2.0-in. to 14.0-in. dia and from 9 to 2300 lb in weight, Commander Keighley said. The 6.5-in. shaped charge head was designed, produced and put into service use in Korea in 23 days.

Not a single rocket was in service use in this country at the time of Pearl Harbor, Commander Keighley revealed. By the war's end, the Navy was producing rockets valued at $100 million a month in 1200 plants.

Planes and guns must be considered in the same relationship as gun and ammunition—one with out the other is useless, Col. Rene R. Studler, chief, Small Arms Development Div, Army Ordnance Corps, told the members. All too frequently, aircraft armament has been an afterthought.

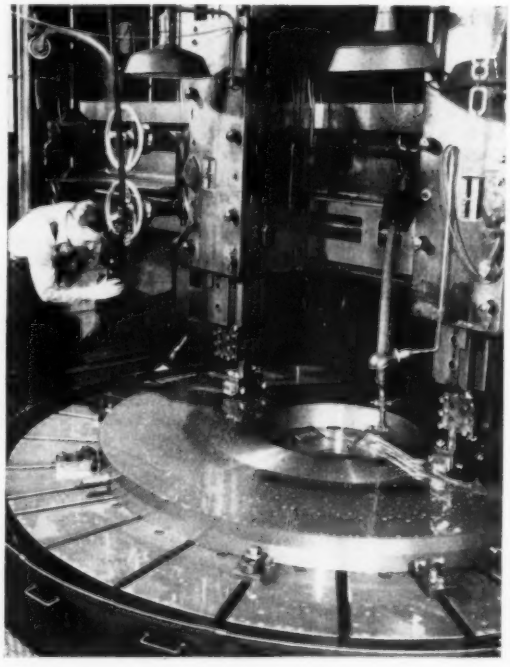
Col. Studler said that good steel and aluminum cartridge cases are needed. Automatic gun ammunition in larger calibers must be made with a high degree of uniformity.

• **A new anti-submarine rocket**, with range above 1000 yd and controlled by a complete fire-control system is greatest and most radical advance in underseas warfare, Capt. H. P. Cooper, program director for Aviation Ordnance, Planning & Progress Div., Navy Bureau of Ordnance, revealed. Rockets, "hedgehogs," depth charges and anti-submarine torpedoes now are controlled.

Aircraft armament is lagging behind performance of aircraft and its power plant, Brig. Gen. Gordon A. Blake, Chief of Weapons Components Division, Air Research & Development Command, Wright Field, charged. Moreover, aircraft armament, with its great dependence on electronic techniques ,is lacking in reliability. We are fighting in Korea with practically the same aircraft guns as in World War II—the Browning 0.50 cal. and Hispano 20 mm.

Greatly increased speed of jet bombers has made necessary extensive bomb redesign, Gen Blake said. Electronic components, especially vacuum tubes, have given trouble due to temperature, humidity, altitude and vibration, Gen. Blake said. "We have plenty of debugging in mechanical, explosives, optical, propellants, and other areas. Components which cause failures in complex armament system total in the hundreds. There is a dangerous trend toward complexity in design, which should be avoided.

• **A tremendous job of rebuilding** equipment for Korea—trucks, trailers, tanks, other combat vehicles—has been carried on in Ordnance shops and depots in Japan, Maj. Gen. E. L. Ford, Chief of Army Ordnance, declared. The true test of this rebuilt equipment has been its fine performance on the field of battle.



A mirror-smooth finish is put on the rotating element of a hydrogenerator thrust bearing in this final grinding operation at General Electric's Large Motor and Generator Department in Schenectady, N. Y. The bearing supports a load of almost 2-million lb. The polished surface establishes a film of oil only a few thousandths of an inch thick which separates the rotating element of the bearing from the stationary part

Glenn B. Warren

James M. Crawford

Gunnar Palmgren

William Irrgang

Names in the News

Glenn B. Warren has been appointed general manager, Turbine Division, General Electric Co., Schenectady, N. Y. **James M. Crawford** was named general manager of GE's Motor and Generator Division. Other General Electric executive appointments include: **Francis E. Fairman, Jr.,** named general manager, Transformer and Allied Products Div.; **George E. Burens,** general manager, Switchgear and Control Division; and **Harold E. Strang,** named general manager, Measurements and Industrial Products.

Edgar F. Kaiser has been elected a member of the board of directors, Kaiser Aluminum & Chemical Corp., Oakland, Calif. **William P. B. Marks** was elected vice president and secretary. They fill vacancies created by the death of **G. G. Sherwood.**

Arthur N. Dugan, vice president of the National Bearing Div., American Brake Shoe Co., New York, has retired after 37 years service, but will continue his connection with the company as a consultant.

Wilbur E. Lunger has been elected a vice president, American Car & Foundry Co., New York. He joined the firm in 1914, and previously was assistant vice president of the production department.

Leon R. Steffen has been named director of purchases, AC Spark Plug Div., General Motors Corp., Toledo, Ohio. He succeeds **Herbert R. Wells,** retired.

Warden F. Wilson has been elected president and general manager, Donegal Mfg. Corp., Marietta, Pa.

Gunnar Palmgren has been elected a vice president of SKF Industries, Inc., Philadelphia. Mr. Palmgren will be in charge of the company's engineering and research. He has been with SKF for 32 years, and was assistant vice president and chief engineer prior to his present appointment.

Dr. Arnold O. Beckman has been elected president, Instrument Society of America, Pittsburgh. Other officers elected by the society include **David M. Boyd** and **Robert T. Sheen,** elected vice presidents.

Robert Barit has been elected vice president in charge of purchasing, Hudson Motor Car Co., Detroit. Mr. Barit succeeds **G. W. Munger** who has retired after more than 32 years of service.

W. C. Landis, vice president, Westinghouse Air Brake Co., has been appointed general manager of the Air Brake Division of the company at Wilmerding, Pa. and Emeryville, Calif. **A. M. Wiggins,** vice president, was named general manager of the Union Switch & Signal Div.

William L. Fader has been appointed general superintendent, Christy Park works, National Tube Co., a U. S. Steel Corp. subsidiary at Pittsburgh. He succeeds **Arthur C. Landis,** deceased. **Eugene C. Kennedy** was appointed superintendent of U. S. Steel's Gary, Indiana works.

William V. Shakespeare has been appointed sales manager, Thor Export Sales Div., Independent Pneumatic Tool Co., Aurora, Ill. He has been with the firm since 1937.

William Irrgang has been elected executive vice president, Lincoln Electric Co., Cleveland. Mr. Irrgang has been with Lincoln since 1929, and has been director of plant engineering since 1945.

A. B. Fisher, Jr., has been named operating manager, Koppers Freyn Engineering Dept., Koppers Co., Inc., Pittsburgh. He was formerly chief engineer for the Engineering & Construction Division of the company. Mr. Fisher succeeds **Gordon Fox,** who retires Jan. 1, 1952 but will continue in a consulting capacity with the company.

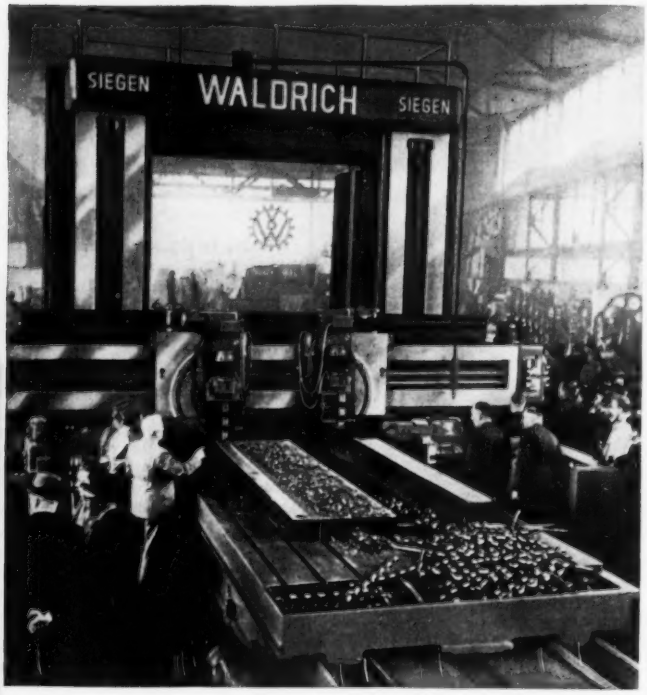
James H. Wolcott has been appointed sales manager of the machinery division, Reed-Prentice Corp., Worcester, Mass. He has been with the firm since 1937.

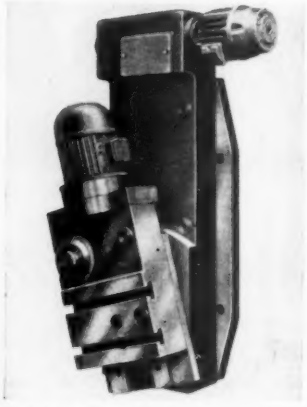
OBITUARIES

J. E. MacLaren, managing director of B. S. A. Tools Group of companies, including B. S. A. Tools, Ltd., Birmingham, England, died Oct. 2. Mr. MacLaren was formerly a director of Buck and Hickman, Ltd., London. He joined B. S. A. as managing director in 1946 after wartime service with the British Ministry of Supply. He is a native American who has been associated with the British machine tool industry since World War I.

Thomas L. Lord, 71, retired president, C. F. Pease Co., Chicago, died Sept. 16. Mr. Lord joined the Pease company in 1910 as director and treasurer, in 1922 he became president and held this office until his retirement in 1945. Following his retirement, he remained as a member of the board of directors until 1950 when he resigned.

New Shop Equipment





Toolholder is power lifted and power clamped so that it cannot give way at the start of the cut. For the cutting of deep grooves, the tool alone is lifted vertically with a max. stroke of 8 in. In addition, the toolhead is clamped to the vertical and horizontal slides by hardened cup springs

Material of 0.60% C with a tensile strength of 112,000 psi and an elongation of 10-12% is being cut here at a speed of 265 fpm. Chip cross-sectional area is 0.124 sq. in. Machined surface is extra smooth

High-Speed Planer Rigidly Clamps Tool

Planing with carbide-tipped tools requires the tool shank to have an unusual amount of resistance. In order to obtain the most favorable cutting-edge load, the set angle of the tool must be kept as small as possible, and the entire cutting edge must be utilized. Doing this, it is possible to choose a large feed while the chip thickness remains the same. The Waldrich-Siegen planer, because of its method of clamping the tools and its rigid cosntruction, is able to realize the advantages of carbide tools.

In most designs, the toolholder slides back into working position after the return stroke of the table by the action of its own weight. The necessary play for the sliding of the holder on the guides of the head cannot be avoided. This margin permits a measurable off-movement of the tool at the beginning of the cutting stroke.

This German planer uses a power-operated and power-clamped toolholder. The tool cannot give way at the start of the cut. The tool itself lifts vertically when cutting deep grooves and it, too, is automatically clamped in its working position before the beginning of the cut.

In most planers the head itself (because of a margin of play on the crosshead) can give way at the beginning of the cut. On the Waldrich-Siegen, the toolhead is clamped to the vertical and horizontal slides just before the adjustment for feed occurs.

The width of the columns has been increased 150% over former machines built by the company. Also, the columns are no longer shaped so as to give equal over-all stress, but are now formed prismatically. This, together with ribbing, results in high rigidity and in favorable swinging dynamic characteristics. The addition of a baseplate to the framework has also increased the rigidity.

In order to transmit the cutting force to the columns and to absorb it, the crossrail penetrates the entire depth of the housing at the rear end and culminates in a T-shape—joining the column at four oblong connections.

A Ward-Leonard unit drives the table by means of helical gearing to the table gear rack. Accuracy of table movement is claimed to be ± 0.0177 in. The guideways are covered by fibre plates with a low coefficient of friction. This eliminates sizing, even when no lubricant is used. The guideways are V-shaped. Importer:

Kearny Mfg. Co., Inc., Kearny, N. J.

Materials and Parts

P&J Automatic Turret Lathe Has Electro-Pneumatic Control

Potter & Johnston has added to its line of automatic turret lathes with its Model 10-U, an oversize lathe, designed to handle the biggest production jobs. The lathe has a 49-in.-dia swing over base ways, a 36-in.-dia swing over cross slides for chucking, and a 27-in.-dia swing over cross slides for machining.

Individual front and rear cross slides, operating from separate timing boxes, can be controlled independently or simultaneously with the movement of the turret slide. Having a 25½-in. adjustment along the bonded tool-steel base ways, the front and rear cross slides and selected tools may be positioned to work from the rear and on the face of the work at the same time that the turret tools are machining. Cross-slide travels are fixed at 8½ in.

Distances from spindle to turret are listed as a minimum of 30 in. and a maximum of 50 in. Distance, center to center, between the 5-in. wide base ways is 31 in. This, plus four automatic changes of spindle speed and three automatic changes of feed for each set of pick-off gears, working in combination with unique tooling of cross slides and turret, provide an outstanding machine for its capacity.

The 10-U lathe is equipped with multi V-belt drive and a large magnetic clutch and brake. In operation, the main motor runs continuously; the spindle is started, stopped, and jogged by the clutch and brake at the motor. High current inrushes are confined to initial starting and shutdown.

Features of the machine include full electro-pneumatic control; hardened and ground speed gearing; air-operated chuck; and a centralized-control station.

Potter & Johnston Co., subs. Pratt Whitney Div., Niles-Bement-Pond Co., Pawtucket, R. I.

Easy Weighing—Electronically

This electronic scale and recorder features (1) compactness, (2) ease of installation, operation and maintenance. The scale system may be installed at weighing points where a lever system might be impossible or impractical to install. It is also able to record and print the weights at some point remote from the scale.

It is composed of a servo-operated step-cam system and recorder and Baldwin-Lima-Hamilton load cells. Another feature of this equipment is the range-change control. Changing from one range to another is accomplished by adding a resistance in series with a helipod and equal to that of the helipod. This balances the system and brings the recorder back to zero with the preceding load still on the scale.

Streeter-Amet Co., Chicago 13, Ill.

...INCLUDING

Hydraulic machine pierces, trims, rivets by means of separate power cylinders ... page 150

Chrome carbide in some ways superior to tungsten carbide and is lighter ... page 151

Leather packing is rubber impregnated to give a temperature range of −65 to 200 F ... page 151

Coolant filter discharges the solids, in a dry state, in an outside container ... page 154

Working-height lifter is raised, lowered, and stopped by remote pedal switches ... page 156

Lathe attachment has a swivel bar which can be set to the proper taper from scale ... page 158

Tapper has a compound table so that any hole in a 24x40-in. workpiece can be centered under the tap. Solenoid brake locks table ... page 160

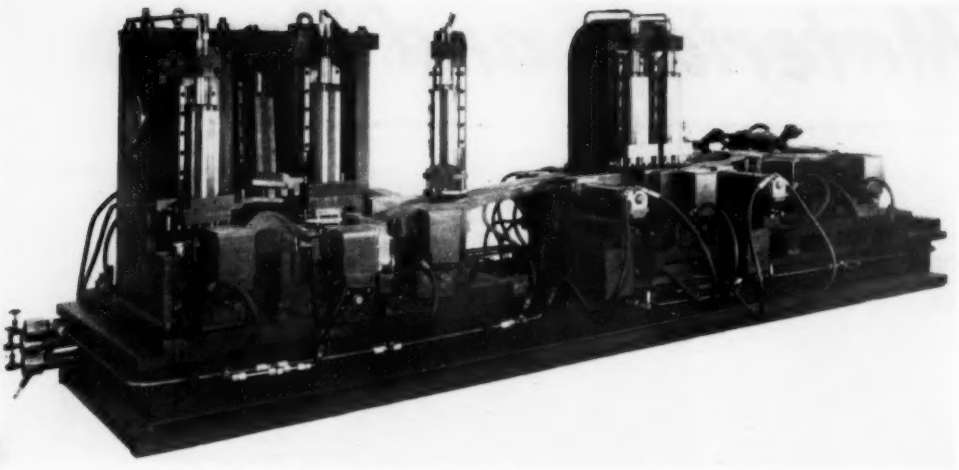
Automatic cold-sawing machines employ a hydraulic feed which prevents the blade from being drawn into the work ... page 162

Radial drills use an electro-hydraulic system to lock the column and head ... page 164

...and in Nov. 11

Vertical boring mill has cross-rail and side heads individually controlled by sets of feed and rapid-return gears

Grinder brings coolant to section of highest temperature by feeding it through the wheel



This 16-unit hydraulic machine pierces the holes in the flanges and web of automotive-frame side bars in one simple operation. The action of each cylinder features automatic hydraulic blankholding and stripping action.

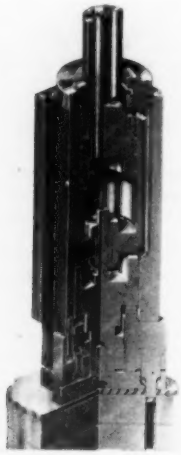
Danly Hydraulic Machine Pierces, Trims, Rivets

Originally patented by the Mueller Engineering Company of Dearborn, Mich., these hydraulic machines are finding increasing applications in the automotive and aircraft industries. Typical operations are the simultaneous piercing of all holes and the trimming of automotive frame members, production riveting assembly operations on automotive frames, and producing accurately pierced holes and related assembly operations for jet-engine components.

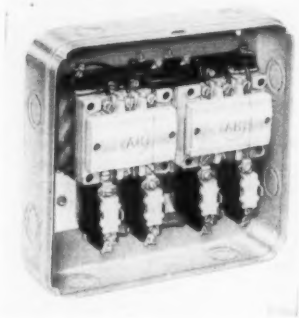
This wide range of applications is said to be due to the special features contained in the hydraulic cylinder — the basic unit of the machine. Built-in blankholding and stripping action, which is entirely automatic and requires no springs, is actuated hydraulically after the power stroke. The rigidity of this construction permits producing holes under difficult conditions, such as punching steel that is thicker than the hole diameter. In one instance, it is reported that 21/64-in.-dia holes are punched in 5/16-in.-high-carbon SAE-1095 steel heat-treated to 41 Rockwell C.

Principal features of the hydraulic system include continuous pressure intensification allowing cylinders to be added to the circuit. A transfer valve handles extremely high pressures while eliminating hydraulic shock in the circuits. These features are the basis for capacities up to over 200 tons in relatively small compact cylinders. These machines may also be used as small piercing units and riveting machines.

Danly Machine Specialties, Inc., 2100 South Laramie Ave., Chicago 50, Ill.



This cutaway view illustrates the action of the basic power cylinder. Stripping and blankholding are entirely automatic requiring no spring or additional values. Compact design makes it possible to arrange these units at any angle in confined areas.

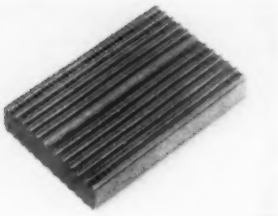


Motor Starters Use Right-Angle Operating Mechanism

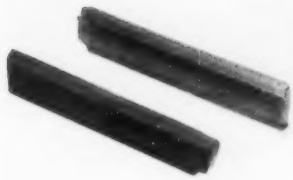
Designated Model RAR and RAS, two motor starters extend the scope of the Arrow-Hart RA Magnetic Starter line to include reversing and multi-speed motors. The RAR (Reversing) and RAS (Multi-Speed) feature right-angle operating mechanism. Among other advantages claimed for this advanced design are: greatly reduced size and weight with increased operating efficiency, simplified straight-thru front wiring and more complete protection of electromotive equipment.

Supplied in sizes 0, 1, 2, 3, and 4, these starters will be adapted to a wide variety of uses. NEMA Type I steel housings are available for all-round indoor use; NEMA Housing Types IV, VII and IX are also supplied adapting the starters to use in hazardous locations.

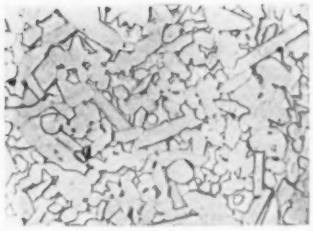
Arrow-Hart & Hegeman Electric Co., Hartford, Conn.



Chrome carbide is being used to make gage anvils (Also gage blocks, ring and plug gages) because of its ability to resist corrosion and abrasion. As its coefficient of expansion is about that of steels, readings are not affected by temperature variations



A higher resistance to combined corrosion, erosion, and abrasion for chrome over tungsten carbide is demonstrated by these centrifuge blades. Both were run for 6 weeks. The tungsten-carbide blade is at the front, the chrome-carbide blade at the rear



Uniformity of grain size and the interlocking microstructure are characteristics of chromium carbide. Magnification is 1500 diameters. Parts made of the material seem to be completely stable, with no internal strains. Machinability is similar to tungsten carbide

Chrome Carbide Best for Corrosion, Abrasion

A family of chromium carbides, known as Series 600, have physical properties which are better in many respects than tungsten carbides. The new carbide has high resistance to abrasion, erosion, and corrosion; lighter weight; a coefficient of thermal expansion the same as that of steels; and extreme resistance to oxidation even at high temperatures. It is completely nonmagnetic.

Corrosion—After subjection to a salt-spray for 50 hours, the test samples of Chromium C still retained their metallic lustre. With sulphuric acid as the corrosive agent, Series 600 showed about 30 times the resistance of 18-8 stainless and 3 times the resistance of conventional carbides. With nitric acid, the resistance was 8 times that of other carbides, twice that of stainless. It was found to be practically inert when exposed to citric or lactic acid.

Oxidation and Erosion—Chrome carbide appears to be completely resistant to oxidation at all temperatures up to 1000 C (1832 F). When subjected to a temperature of 1850 F for 24 hours, it maintained its lustre, while simultaneously exposed samples of stainless and tungsten carbide had completely disintegrated.

Erosion tests conducted with steam indicated a resistance approximately 50 times that of conventional carbides.

Machineability—About the same as tungsten carbides. Series 600 appears to have sufficient toughness to permit grinding without chipping.

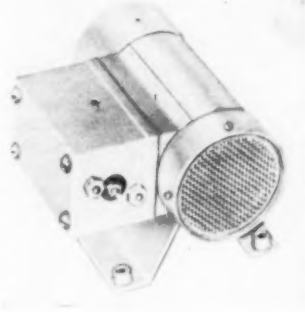
Hardness — Much higher than steels. About the same as tungsten carbides at room temperature (approx. 80-93 R.).

Strength — Compressive strength far higher than most steels.

Series 600 will be available at the outset in the complete size and shape range in which tungsten carbides are offered. There are apparently no inherent physical limitations as to size and shape eventually producible, however.

The material can be brazed, and may also be attached by mechanical means. Another method that can be used is cementing with thermo-setting resins.

Carboloy, Div. General Electric Co., Detroit 32, Mich.



Vane Axial Blowers Provide Maximum Air Volume

The Vane Axial Blower is extensively used in cooling all kinds of electronic equipment and is applied in glove-fit locations.

Standard models are supplied in diameters of 2, 4, and 6 in. Intermediate sizes are available. The blowers are 400 cycle, 3 phase and single phase; 60 cycle single phase; at 27½ v dc. Speeds range from 3300 to 10,000 rpm depending on pressure and volume requirements. Construction is of aluminum.

The motor is located within the air stream and is effectively cooled by the fan blast, allowing the motor to run at top efficiency and providing maximum air volume and pressure.

Stanat Tool & Machine Co., 47-28 37th St., Long Island City, N. Y.

Houghton Leather Packing Is Rubber-Impregnated

After extensive field testing in industrial applications, a rubber-impregnated leather packing has been announced for applications as cups and V's. The material is mineral-tanned VIM leather, impregnated throughout with a synthetic elastomer, then polymerized for bonding. Former impregnants were based on waxes which softened at 150F.

The packing is suitable for temperatures ranging from —65F to 200 F, and for pressures as high as conventional wax-impregnated leather. It is claimed to be resistant to plastic flow, oils and solvents, and abrasive. Because of its elasticity, it is much easier to install than wax-impregnated leathers.

The impregnation produces a pliability heretofore found only in rubber packings.

E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33, Pa.

Large Throat on Pullmax Nibbler For Inserting Bulky Work

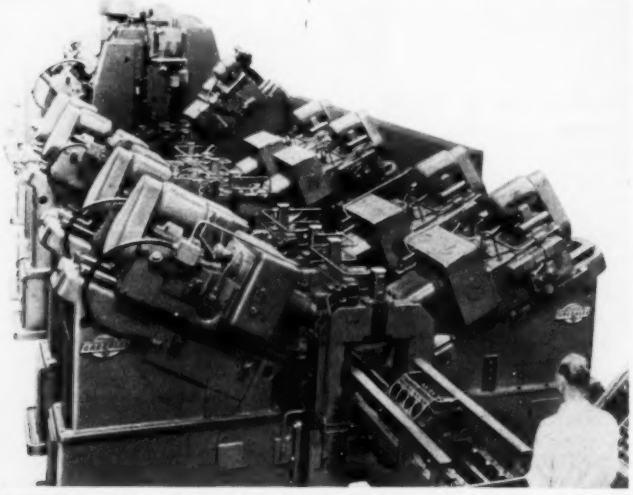
Because of increased clearance, this 9/32-in.-capacity machine can be equipped with longer tools—with resulting longer life before changing. Another feature is the quick-locking devices on both the circle- and straight-cutting attachments. Setup is faster since no tools are required. Another aid is the graduated (in.) lower guide rail.

The lower toolholder has been improved for simpler setting and adjusting.

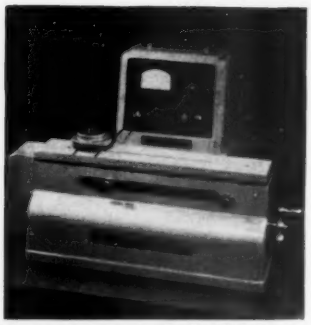
Known as the D-3, the model can do beading, folding, slot cutting, nibbling, and louvering, simply by changing tools and attachments.

The box frame is made of welded steel plate. All moving parts are enclosed and operate in an oil bath.

American Pullmax Co., Inc., 2627 N. Western Ave., Chicago 47, Ill.



SIXTEEN-STATION AUTOMATIC TRANSFER MACHINE finishes 81 automotive-cylinder blocks per hr at 80% efficiency, performing 123 operations in 35.5 sec. It completes semi-finish reaming, finish reaming, and tapping operations. — ***Greenlee Bros. & Co., Rockford, Illinois.***



Electronic Gage Head Added To Internalchek by Sheffield

A remote electronic-gaging head is now being supplied with the N-6 Internalchek by the Sheffield Corporation. Standard dual amplifications are 1000/2000, 300/3000, 5000/10,000 to 1. Other amplifications are available on special order. This instrument is normally used in the tool room or gage laboratory for checking master and working ring gages, setting snap and length gages, for checking tools and other high-precision work having one or more internal dimensions. It is also ideal for use where small runs are made of a great variety of bore sizes which have close tolerances. Precision blocks or masters are used as reference in setting up the instrument. Both bench type and console base are available.

The Sheffield electronic gage head consists primarily of a highly stabilized vacuum-tube circuit which gives indication on a high-speed meter. A built-in regulating transformer controls fluctuations of 95-125 Volts to within 1±. The elimination of drift in the circuit permits accurate measurements continuously or intermittently, over long periods of time without constant resetting.

The N-6 has a wide gaging range from a minimum diameter of 0.370-in. to a maximum diameter of 12-in. Maximum gaging depth from surface plate to center of diamond point is 1-½-in. By turning the part over, another 1-½-in. depth of the hole may be checked making it possible to explore a hole 3-in. deep throughout for diameter, taper, bell mouth, and out-of-round conditions. Capacity of the standard instrument is sufficient to accommodate an A.G.D. ring of the largest size. On special order the N-6 may be supplied with gaging arms for checking holes down to and including 240-in. in diameter. The maximum gaging depth from the surface plate to center of diamond points on these arms is 1 in.

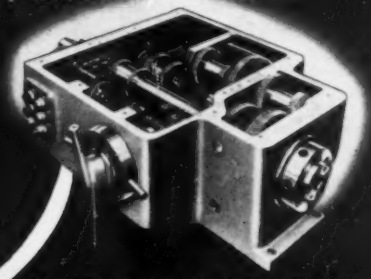
The Sheffield Corp., Dayton, Ohio

NOT JUST ANOTHER LATHE

but a Sidney Lathe!

Check these features...

✓ Change gears rotate on anti-friction bearings and are mounted on fixed centers. Driving sheave is mounted on pre-loaded anti-friction bearings and is full floating on sleeve bolted to back of headstock. Drive shaft deflection is thus eliminated.



✓ All-herringbone geared headstock provides 32 pre-selective changes of spindle speeds through convenient dial control. Spindle and intermediate shafts are equipped with center bearings in addition to end bearings. Spindle mounting automatically compensates for expansion caused by temperature rise.

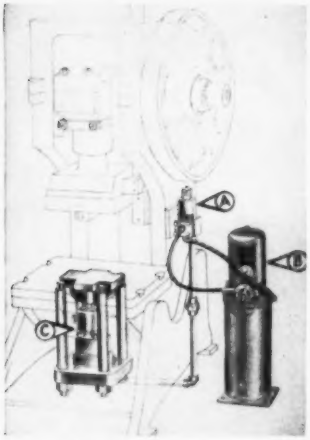
✓ Sidney's totally enclosed dial controlled gear box provides 60 changes of threads and feeds. All moving parts run constantly in oil.

✓ Controls are conveniently located for comfortable operation. Off-set compound—extra large micrometer dials—thumb screw dial lock. Notice also the four swivel hold-down bolts for added rigidity.

✓ Rigid four-wall bed construction with double cross girts spaced at 12" intervals. Casting is of semi-steel nickel mixture for close grain structure.

SIDNEY MACHINE TOOL COMPANY • SIDNEY, OHIO

Builders of Precision Machinery Since 1904



Bed Jack Can Be Used With Any Power Press

This Hydraulic Overload Press Bed Jack can be used to advantage on all operations such as riveting, marking, stenciling, squeezing, assembling, forming, swaging, staking, etc.

It is fastened directly to the bolster plate or press-bed frame, see figure (C). Figure (B) is the hydropneumatic pump that can be operated directly off the average shop air line. The control valve (A) can be set at any desired tonnage or overload protection to both the press and the tools.

The jack assures a constant working pressure at all times at the point of operation, and will compensate for variations in material thickness. The equipment can be easily applied to any power press and is removable when not in use.

The attachments are available in eight sizes, up to and including a maximum of 200 ton.

Dayton Rogers Manufacturing Co., Minneapolis 7, Minn.

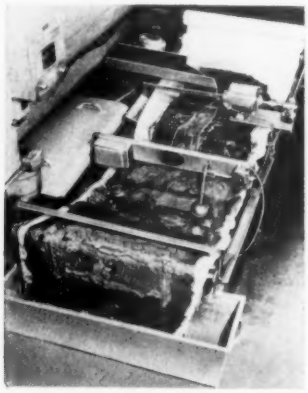
Fractional-hp Motor Has High Starting Torque

This special-service, split-phase, fractional-hp motor has a high-starting torque for use where high starting current is not objectionable. Breakdown torque is in accordance with NEMA standards for the basis of rating. Service factor is 1.00.

Features of the motor include: rigid cast-iron end brackets of drip-proof design rigid welded-steel frame; thick-walled phosphor-bronze sleeve bearing with thrust collar; wool-yarn lubrication with reserve oil capacity. Shaft is precision ground, rotor is high-pressure cast aluminum and each is dynamically balanced. Rotor lamination is skewed for quiet operation.

These motors can be furnished with cushion base, if desired.

Century Electric Co., 1806 Pine St., St. Louis, Mo.



Delpark Coolant Filter Uses Automatic Process

The Delpark coolant filter is a continuous, self-cleaning gravity filter. It filters solids from liquids that will flow by gravity through filter material and discharges the solids, in a relatively dry state, in an outside container.

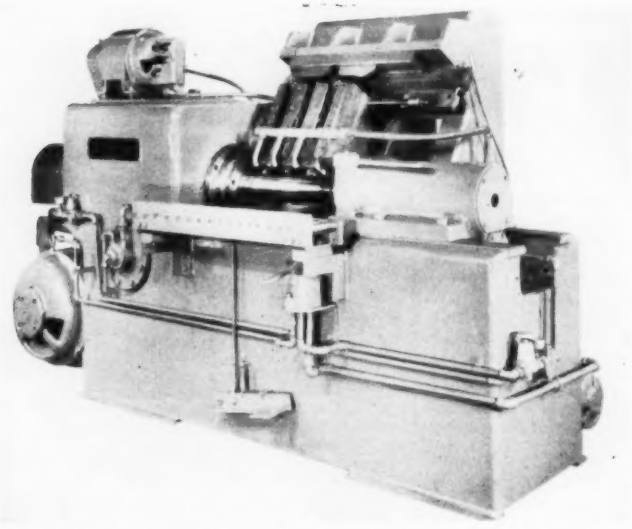
The filter material, fed from a roll, rests on, and conforms to, a flat endless conveyor of open construction. Sloping sides form a shallow pool of the conveyor and an inclined discharge ramp provides for removal of filtered solids.

Using an automatic process, controlled by a float and variations in the liquid level, down time of grinders for cleaning of reservoirs is eliminated and coolant life is extended.

The filters, in many cases, fit into or over existing coolant tanks. Capacities range from two gallons per minute to units capable of filtering several hundred gallons per minute.

Among its applications are filtering oil used in run-in of engines, gears, transmissions, quenching oils, and parts-washing solvents.

Industrial Filtration Co., Lebanon, Indiana.



SHELL LATHES are available in three sizes to handle 75 to 240-mm shells. Machine operations include cutting-off the open end to proper length and facing the base; rough turning and finish turning—*The Wm. K. Stamets Co., Pittsburgh 22, Pa.*

BUSINESS IN MOTION

To our Colleagues in American Business . . .

The fact that a Revere Distributor is now celebrating its 125th anniversary year is an indication of the service the company has given its customers through those years. It is also another proof of the essential function performed by distributors for American industry. Most goods, whether industrial materials such as copper and copper alloys, aluminum alloys, iron and steel, or consumer articles such as refrigerators, radio and television receivers, kitchen utensils and ranges, go through the hands of distributors. Generally speaking, only the large buyers are in a position to purchase direct from manufacturers, who do not find it economical to handle the smaller orders. Yet those orders when pooled in the hands of an organization set up to handle them attain sizable totals, and hence a good distributor account is exceedingly attractive to a large manufacturer such as Revere.

A distributor serves not only the factories from which he buys. He also performs an invaluable service to his customers by making quickly available to them the products they require. A machine shop, for example, may need only a few hundred pounds of brass rod; there is a distributor within easy reach who can furnish it almost immediately. Or a contractor may want a few pieces of steel pipe and a thousand feet or so of copper water tube. Again, the distributor has them. A metal products distributor has to carry such items and an infinite number of others. The Revere Distributor who started in business 125 years ago actually has in stock 53,000 different items, cataloged, indexed, and held in warehouses ready for immediate shipment throughout its territory. Each month this stock is drawn upon by 5,000 to 8,000 customers, each order relatively small. There are many Revere Distributors with similar stocks and offering equal service.

To keep this distributor's warehouses filled with a balanced inventory, 18 people are required in his purchasing staff, which includes specialists in various kinds of materials, machines, tools and supplies. And to serve customers with information, quotations and the like, 25 salesmen are on the go constantly, calling on manufacturers, contractors, builders and stores throughout the busy industrial area in which the distributor operates. The large business done by the company is in great contrast to that of 125 years ago, when it was little more than a hardware store. The enterprise has grown in the American tradition of freedom to prosper in accordance with the principles of reliability and efficiency, fair dealing and integrity in performing a desired function.

Revere Distributors are selected for their ability to serve, and also chosen as to location, so that no matter where you are in this big country of ours, there is a Revere Distributor within easy reach. Today metal stocks may be short due to defense demands but manufacturers are doing everything possible to keep distributors supplied.

If you buy from distributors we suggest you remember that they are not only "central stockrooms," but have a great deal of special knowledge about the products they sell and can give you much helpful advice. Not only that, through the Revere Distributors you can be put in touch with the Revere Technical Advisory Service, which will cooperate with you on matters concerning the selection and fabrication of the Revere Metals. Our distributors, and those of every other manufacturer, render many essential services, both to those to whom they sell, and to those from whom they buy. The distributor system as it operates in the United States arose in response to the need for it. Today it fulfills that need more effectively than ever before.

REVERE COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

Executive Offices:

230 Park Avenue, New York 17, N. Y.

150th YEAR OF SERVICE TO AMERICA

SEE "MEET THE PRESS" ON NBC TELEVISION EVERY SUNDAY

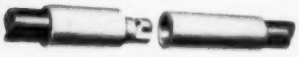
200-amp Transformer Welder Available in Four Models

The Airco Model MCM 200-amp transformer welder has been designed for general maintenance and production welding. It has a full 200-amp, 50% duty cycle, NEMA rating.

Two open-circuit voltages are provided, 80 v on the low range and 55 v on the high range. This combines easy arc starting with a lower KVA demand load and primary ampere current. A current indicator is used to provide quick adjustment of welding current.

Four variations are available: 220 v or a 220/440/550 v unit, each with or without power-factor correction.

Air Reduction Co., Inc., 60 East 42nd St., New York 17, N. Y.



Welding-Cable Connectors Use Double-Cam Principle

The Cam-Lok welding cable connector is made of solid brass machined to a smooth sliding fit. The design consists of a double-cam principle with one cam exerting pressure parallel to the axis of the connector, the other perpendicular to the axis. Contact approaching the 600 lb psi needed for minimum resistance is obtained .

General-purpose Cam-Lok connectors (for 1/0 through 3/0 cable and No. 2 through 1/0 whip ends) are completely interchangeable with other Cam-Lok connectors. Long runs of cable can be graduated from 4/0 down to a light whip end for maximum flexibility and minimum voltage drop. No adapters or reducers are needed.

The connector is self-compensating for wear, locks tight, releases easily, has no spring action, and reduces arcing and burning because of the high pressure applied by the two cams.

Cam-Lok, a division of Empire Products Inc., Cincinnati, Ohio.

Coles Mobile Crane Uses Reversible-Steering Box

A mobile crane, the Ulysses, has been designed as a precision-lifting tool by Coles Cranes, Inc. The crane has a full-circle swing and is capable of lifting its maximum-rated load throughout any point in the full circle of swing.

It uses gasoline-electric power for maximum smoothness and economy of operation. The cost of running this crane for an eight-hour day is said to be approximately six gallons of gas. The power unit is a gasoline Ford V-8, 47 hp at 1800 rpm and a diesel Pelapone or equivalent at 44 hp at 2000 rpm.

The boom is cantilever-lattice construction in lengths from 12 ft to 40 ft. An additional lifting point at 17 ft can be supplied. The capacity of the boom ranges from 1750 to 15,000 lb.

Special features are the automatic safe-load cutout and indicator which prevents overloading and reduces the possibility of tipping. A reversible-steering box is provided which enables the operator to steer conventionally whether the boom is placed to the front or rear of the crane.

Coles Cranes Inc., Joliet, Ill.

Soluble Oil is said to be able to withstand terrific heat for long periods, and resist contamination. It adheres to the tool and carries through to the cutting edge and mixes readily with water. The oil does much to keep chips from welding to the tool, because of its tenacity to the tool and its maintenance of the high-heat transfer of water. Triple-Chip resists rust, and has been found non-injurious to the skin, odorless, smokeless, and non-corrosive; helps prevent flying material, and maintains its properties in storage.

Motch & Merryweather Machinery Co., 715 Penton Bldg., Cleveland 13, O.

Working-Height Lifter Has 2-Ton Capacity

This piece of positioning equipment has been designed to keep the work at a convenient working height, thus reducing operator fatigue and eliminating lost production time. Lifting, stopping, and lowering of the load is controlled by remote pedal switches mounted on a single-steel plate which can be conveniently located.

The lifting and lowering mechanism consists of a 1/3 hp, 115 v, 60 cycle, ac motor connected to a piston pump which delivers oil under pressure to the hydraulic lifting ram. The ram itself is fitted with a chrome-plated plunger, replaceable-bronze guides, spring-loaded packing, and a flow-regulator valve to control lowering of the platform at a safe uniform speed under all loads.

It is made in 4000 lb capacity, 42-in. lifting height, and 72 in. over-all height in platform lengths of 36, 42, 48, and 54 in.

The pan platform lowers to the floor so that unit loads on skid platforms or pallets can be readily placed on the lifter by means of a lift truck.

Lewis-Shepard Products Inc., 194 Walnut St., Watertown 72, Mass.

Rossaul Copper-brite is a safe bright dip for brass, copper, bronze, nickel silver, phosphor bronze, beryllium copper, and most copper alloys. It meets government specifications for bright dips on non-ferrous metals. It is said to leave no residue that will interfere with conductivity after a clear water rinse and leaves non-ferrous metals in a passivated state, resistant to further oxidation. It is available in one-gallon bottles and thirteen-gallon carboys.

Rossaul Co., 170 Fifth Ave., New York 10, N. Y.

Jack-Lock® CARBIDE TIPPED MILLING CUTTERS

Cut Cost On and Off the Job

● Standard McCrosky JACK-LOCK Milling Cutters are soundly engineered according to principles of milling and of chip disposal developed and tested in actual operation. JACK-LOCK Cutters can be depended on to remove metal efficiently and to match in rugged construction the power potential of modern machines.

Two exclusive McCrosky features make reconditioning of a cutter a short job. JACK-LOCK wedges—which hold the blades positive and rigid when the cutter is in operation—can be locked and relocked quickly and easily. Adjusting screws behind the blades permit fine and uniform adjustment to provide the very minimum of carbide needed to regrind the cutter to size.

The combined advantages of these two features make the upkeep of McCrosky cutters outstandingly economical:—each set of blades will yield the maximum number of regrinds; the down-time for reconditioning the cutter is greatly reduced; fewer duplicate cutters are needed to keep a production run in continuous operation.

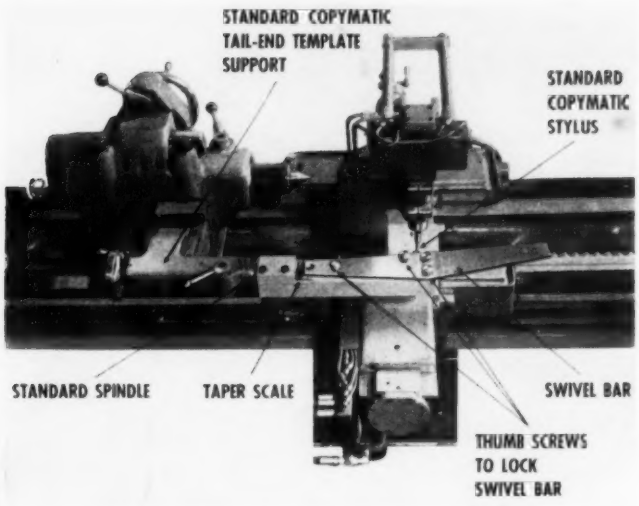
Standard McCrosky Carbide Cutters provide individual designs for milling three different basic materials—cast iron, aluminum and steel—in a wide range of sizes. For complete details send for Bulletin No. 17-M.

McCROSKY TOOL CORPORATION
MEADVILLE, PA.

COST CUTTING TOOLS

Designers and Manufacturers of

Jack-Lock Milling Cutters
Super Adjustable Reamers
Block Type Boring Bars
Turret Tool Posts
Wizard Quick-Change Chucks
Special Multiple Operation Tools



L & S Lathe Attachment Speeds Taper Turning

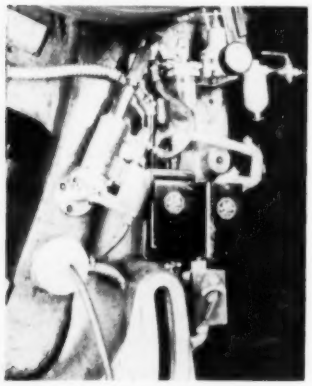
A flat templet device, designed for use with the Lodge & Shipley Copymatic Lathe, is said to make taper turning easier and faster. The desired taper may be set on a direct-reading scale which is part of the attachment. Added convenience and greater versatility are claimed for the unit.

Workpieces which have peripheries or bores of continuous tapers may be contour turned directly from the attachment. When tapers form but a part of the surface, the attachment is used in the production of a round templet. The templet is then placed between the standard Copymatic duplicating centers for tracer-controlled duplication in any quantity.

A swivel bar and scale has been used in the special flat-templet taper arrangement on the Copymatic. The swivel bar, which is mounted on the standard tail-end templet support, may be accurately angled to the desired taper. It takes just a moment to unlock the bar, set it to the proper taper as indicated by the scale, and relock the bar by the thumb screws.

Field installation of the attachment is easily made; inclusion on new lathes is optional at extra cost.

The Lodge & Shipley Co., 305 Colerain Ave., Cincinnati 25, Ohio



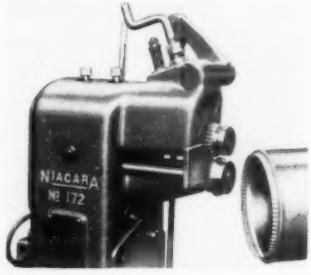
Electric Pneumatic Guard For Direct-Clutch Punch Presses

The Model No. AE 60 is designed for direct-clutch presses having not more than 60-lb. pull and 2 in. of up and down movement on the clutch tripping rod.

The press is actuated by a set of electric start buttons installed in a convenient place on the press—the buttons located far enough apart so that the operator must use one hand on each button. Only by simultaneously pushing both buttons is the circuit completed. An air clutch operator which replaces the treadle engages the clutch, allowing the ram to make one complete revolution. The treadle can be either temporarily disconnected or permanently removed if desired. An anti-repeat switch and long cam will allow the ram to descend only once, unless the solenoid valve is re-energized by use of the two start buttons.

A foot-operated attachment for handling of longstock may also be furnished. Plugging it into the press for blanking purposes makes the press automatic, inactivating the start buttons. A limit switch can be installed in the circuit on interlocking dies so that the press cannot be operated unless the die or work is in the home position.

Tech-n-Kal Machine and Engineering, 12925 Auburn Ave., Detroit, Mich.



COLLAR EDGING ROLLS prepare a round sheet-metal pipe for joining with a flat sheet. The contour of the rolls raises a bead above the surface of the pipe and at the same time crimps the edge so that it is smaller than the pipe dia. The rolls are made of alloy steel, hardened and polished. They are available for the No. 164 universal rotary machine using 24-gage mild-steel maximum, and for the No. 172 electric combination machine using 20-gage max.— *Niagara Machine & Tool Works, 637-697 Northland Ave., Buffalo 11*

Motorized Gear Unit has Speeds Up to 1 Rev. per Month

A motorized gear unit with very low speeds is available as a component or incorporated into chart movers and timers.

There are two series of double gears rotating freely on fixed shafts. Motor power is transmitted back and forth between the series. A pickup gear on the splined output shaft picks up any speed selected by knob and indicated by pointer.

There are two speed ranges: 13 speeds (sec. to a month) and 10 speeds (minute to a month.)

Gorrell & Gorrell, Haworth, N. J.

DOES IT TAKE 8000 HOURS TO TRAIN A TOOL & DIE MAKER?

IF so he's an important person—too important to be spending his time and talent on steel of uncertain work value, or on routine "get-ready".

Designed especially for him are WARPLIS squares and flats of truly fine quality oil hardening, *non-warping*, tool steel in this standard analysis which he knows and trusts:

Carbon .90 Manganese 1.10 Chromium .50 Tungsten .50 Vanadium .15

. . . each piece ready for his advanced skills—precision ground and decarb-free, corners square, sides flat and parallel.

His nearest fine steel distributor carries WARPLIS in the wide range of sizes shown below—each piece marked with size and brand, each in its own protective wrapper bearing simple heat treatment:

Squares

Stock Sizes, 18" Lengths

1/8	5/32	3/16	7/32	1/4	5/16	3/8	1/2	5/8	3/4	1	1 1/4	1 1/2	2	2 1/2	3

Flats

• Denotes Stock Sizes, 18" Lengths

Thickness (Inches)	Width (Inches)													
	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6	8	10
1/64			•		•	•	•	•		•				
1/32	•	•	•		•	•	•	•	•	•	•	•		
3/64	•		•		•	•	•	•		•	•	•		
1/16	•	•	•	•	•	•	•	•	•	•	•	•		
5/32	•	•	•		•	•	•	•	•	•	•	•		
1/8	•	•	•	•	•	•	•	•	•	•	•	•		
5/32	•	•	•		•	•	•	•	•	•		•		
3/16	•	•	•	•	•	•	•	•	•	•	•	•		
7/32			•		•	•	•	•		•				
1/4	•	•	•	•	•	•	•	•	•	•	•	•	•	
5/16	•	•	•		•	•	•	•		•	•	•	•	
3/8	•	•	•		•	•	•	•		•	•	•	•	
1/2		•	•		•	•	•	•		•	•	•	•	
5/8			•			•		•		•	•	•		
3/4			•			•		•		•	•	•		
1					•	•		•		•	•	•	•	•
1 1/4						•		•		•	•	•	•	•
1 1/2								•		•	•	•	•	•

Larger, smaller and in-between sizes, and special lengths, to order.

Also { Warplis Drill Rod ROUNDS Nearly 200 Stock Sizes

PRICE FOLDERS ON REQUEST

Warplis FLAT STOCK

PITTSBURGH TOOL STEEL WIRE CO.

MONACA, PA.

Since 1902 . . . makers of cold finished fine steels in all sizes, grades and shapes

Keller Pneumatic Thread-Gage Speeds Inspection of Tapped Holes

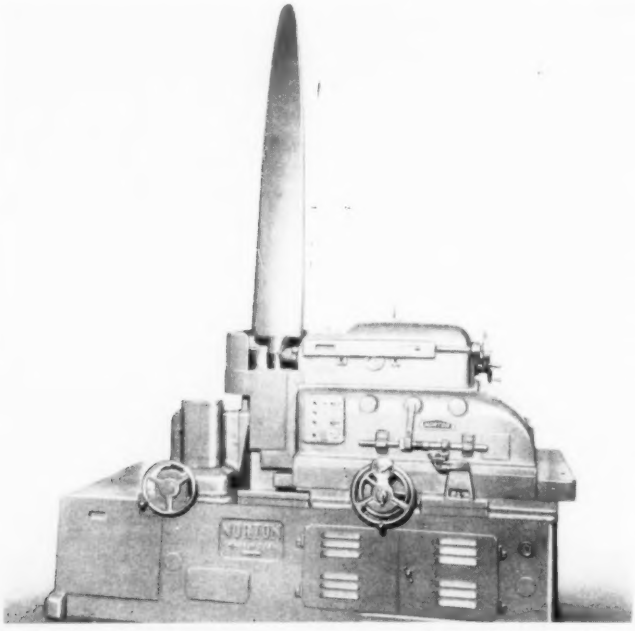
This air-powered tool is used in conjunction with standard taper-locked plug gages. Operation is simple: press, and the motor spins, screwing a "go" gage into the hole; pull, and it reverses, backing the gage out. The tool consists of an air motor with friction clutch and gage adapter—total weight is 34 oz. It can be suspended over the work area by a balancer if desired. For inspecting small parts, the tool may be bench mounted either vertically or horizontally controlled by foot valve.

The rotary air motor turns the gage at speeds ranging up to 300 rpm. The speed is controlled by a built-in air regulator.

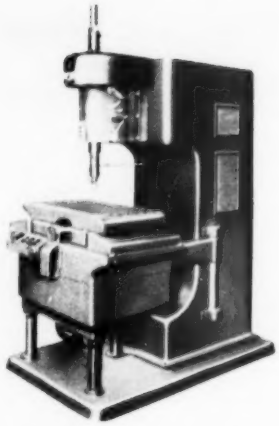
Where the threads being checked are not satisfactory, an adjustable friction clutch permits the gage to stop without stalling the motor. It prevents the gage from jamming or being forced through improperly threaded holes. Friction in the clutch may be increased or decreased to accommodate the gage size and other conditions. Since the clutch is flexibly mounted, slight misalignment in placing the gage against the hole ordinarily does not cause binding.

The tool is furnished with an adapter to accommodate taper-lock gages with thread diameters from 0.510 to 0.825 in. Other adapters handle gages ranging from 0.059 in. to 2.510 in. thread diameter. Adapters are interchangeable.

Keller Tool Co., Grand Haven, Mich.



GRINDER machines the external surfaces of the hubs of aircraft propeller blades, including the ball raceways. A workholding fixture on an antifriction-bearing spindle holds the blade in a vertical position. If the blade were held in a horizontal position, it might deflect from its own weight, and thus produce errors in grinding. The vertical wheel spindle is also of anti-friction-bearing construction. Power positioning of the work spindle and power feed of the grinding wheel simplify operations — *The Norton Co., Worcester 6, Mass.*



Cleveland Compound-Table Tapper For Multiple, Same-Size Holes

Moving freely on ball-bearing raceways, the 28x42-in. worktable has a lateral travel of 20 in. to either side, 13-in. forward travel and 11-in. backward travel from normal standard position. This makes it possible to center any hole in a 24x40 in. workpiece directly under the tap. A push-button-controlled solenoid brake locks the table in any transverse and longitudinal position and holds it until released by pushing another button. The solenoid will not overheat regardless of the length of time the brake is applied.

A motor-operated raising and lowering system, controlled by levers, gives the table 18-in. vertical travel, with table top 56 in. from floor at maximum height. The elevating system consists of three Acme thread screws and ball-bearing-mounted bronze nuts driven through steel sprockets by a continuous double-roller chain. The sprockets are constructed in two pieces to allow fractional tooth adjustment of any screw for accurate leveling.

The machine employs the standard Type E Cleveland head, using hardened tool-steel leadscrews and split bronze leadscrew nuts. Either manual or automatic cycling can be used and limit switches provide for tapping blind holes. Stroke is adjustable up to 5 in. Throat depth is $26\frac{1}{2}$ in. to permit handling of work overhanging the back of the table. The table top has four T-slots for mounting jigs, etc. The machines are manufactured in a number of sizes for tapping holes from $\frac{3}{8}$ to $2\frac{3}{4}$ in., National Coarse thread, in mild steel.

The Cleveland Tapping Machine Co., Canton, Ohio

Get the most out of your
LELAND-GIFFORD
DRILLING MACHINES

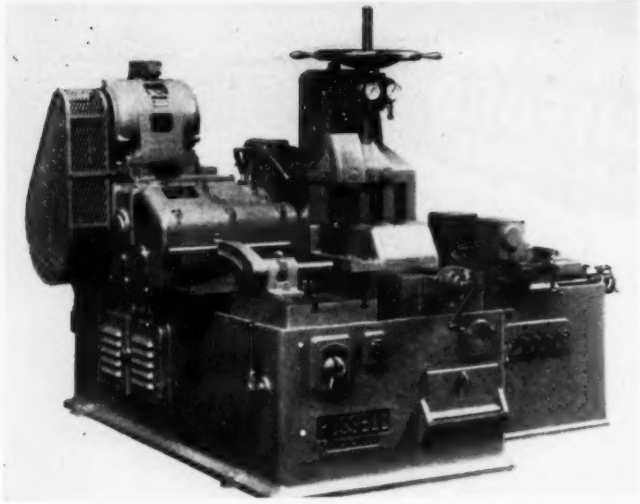
Avoid Excess Tension on Spindle Return Spring

Excessive tension on the return spring contributes nothing to faster production . . . results only in unnecessary abuse of a fine piece of precision equipment. Spindle return is readily adjustable for speed and sensitivity. Correct tension will help to insure the long life and satisfactory performance built into your Leland-Gifford Drilling Machines.

A small point? Yes . . . but important! Leland-Gifford Drilling Machines are built as trouble-free as master craftsmanship and long experience can make them . . . with totally enclosed motors, spline lubrication wipers, oil mist lubricated spindle bearings and many other features to insure lasting precision and safe, dependable operation. But neglect or abuse can impair the performance of even the finest equipment. With reasonable care and maintenance, your Leland-Gifford Drilling Machines will keep on producing accurate holes year after year. Remember, you are making a valuable contribution to the defense effort when you take the best possible care of your production equipment.

SAVE TIME **— CONTACT THE OFFICE NEAREST YOU**

LELAND-GIFFORD
Drilling Machines
WORCESTER 1, MASSACHUSETTS, U.S.A.



Hydraulic-Feed Cold-Sawing Machines Made Fully Automatic

These British machines are used where large quantities of material must be speedily cut to uniform lengths.

The bed is a heavy box-section casting, designed to ensure rigidity during heaviest cutting.

The saddle is made of cast iron and provided with adjustable taper gibs. It houses the 4-V-belt pulley from the main motor, the gear drive to the saw spindle, and the saw blade and spindle. Four speeds are provided. The whole of the gearing is totally enclosed and runs in an oil bath, the level of the oil observed through a glass window.

The hydraulic feed employs a locked system with the following advantages: (1) the saw blade is prevented from being drawn into the work by its own cutting action; (2) there is a steady approach of the blade into the work, with an equally steady break through at the end of the cut. The pump-and-tank unit is a motor-driven assembly housed in the bed. The infinitely variable-delivery pump is controlled by the operator and is used for feeding purposes only. A constant-delivery pump is used for the feed-cylinder counter pressure, work clamping, and automatic quick-return motion of the saddle.

The automatic cycle is hydraulically controlled and easily set up. At the beginning of the cycle, jaws grip the stock and move it forward a distance equivalent to the desired length of the finished piece with loss due to cutting automatically compensated for. Interlocking vises then clamp the material and the saw feeds forward at the rate set by the operator. During cutting, the grippers automatically release and return to their original position. Upon completion of the sawing, the saddle automatically returns and the grippers close onto the stock. When the saddle comes to rest in its rearmost position the vises release, and the stock moves forward.

The vises enable all sections to be clamped without using packing plates, etc. No work stop is required for automatic operation, but one is supplied to assist in the initial setting of the material.

Triplex Machine Tool Corp., 75 West St., New York 6, N. Y.

Hard-Overlay Electrode To Resist Abrasive Wear

Eutechrom 2X is a relatively inexpensive hard-overlay electrode. The alloy provides good corrosion resistance at low amperages, thus minimizing dangers of distortion and stress.

The electrode is recommended for use with carbon and alloy-steel surfaces that are subjected to severe abrasive wear and comparatively mild impact.

It is available in 1/8, 5/32, 1/4, and 3/16 in. diameters.

Eutectic Welding Alloys Corp., Dept P, 172nd St. and Northern Blvd., Flushing 58, N. Y.

Portable Electric Oven With Temperature to 800 F

This electric oven is used for such processes as stress-relieving springs and plated parts.

Construction permits nesting one oven on top of another. They can be used in groups or banks, and selected ovens can be cut-out or heated at different temperatures. Temperature range is 100 to 800 F.

The units are made of heavy-gage steel with Fibreglass insulation. They will operate from any 110-v outlet. A thermostat, outside-reading thermometer, and pilot light are standard equipment. Inside dimensions are 22 in. wide, 18 in. deep, and 16 in. high.

Grieve-Hendry Co., Inc., 1101 N. Paulina St., Chicago 22, Ill.

Chilling machine saves time and money on shrink-fit assembly. It is based upon the predictable shrinkage of metals chilled to 120° below zero F.

The company cites this example: An aircraft manufacturer formerly heated a landing strut for press-fit assembly. Operation time including heating was 20 min. Now the female part is quickly heated in an oil bath, the male part chilled, and the whole operation completed in 10 min, doubling production.

Sub-Zero Products Mfg. Div., Deep-freeze Distributing Corp., 3928 Reading Rd., Cincinnati 29, Ohio.

Tool chest has two full-width, 2¾-in.-deep, two-compartment drawers, four half-width, 1¼-in.-deep, three-compartment drawers, a full-width top section partitioned into three compartments, and a 21¾-in.-wide tote tray with three compartments.

Strength and rigidity are secured by the use of heavy-gage steel, welded construction, double-walled sides, double-reinforced top and bottom, and rounded corners.

Plomb Tool Co., Los Angeles, Calif.

Hjalmar Ellstrom

INVENTOR OF THE GAGE BLOCK

• ESKILSTUNA

The achievement of perfection . . . the mastery of any art, craft, or science . . . is a rare human accomplishment. A discovery or an invention that contributes to the total welfare of all mankind is rarely the heritage left by a single man. So rare is it, indeed, that in such infrequent instances, the true facts surrounding its origin are often distorted, or even lost in the conflicting claims of others who would seek the worldly gains to be derived from undeserved fame.

So it was with the Gage Block. For, actually, this basic standard of measurement used the world around was originally conceived and invented solely and entirely by . . . Hjalmar Ellstrom. Here, briefly, is the story of his accomplishment:

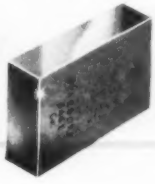
During the early 1890's, Hjalmar Ellstrom was employed by the government rifle factory at Eskilstuna, Sweden. He was a master craftsman . . . a man of infinite patience who took great pride in his work. He was a man of vision, too, who recognized the limitations imposed upon industry by the lack of sufficiently accurate measuring devices. So, with a then unheard of standard of precision as his ultimate goal, he alone developed and perfected his checking instruments and techniques . . . then alone he created the world's first gage block accurate to the infinitesimal millionth part of an inch.

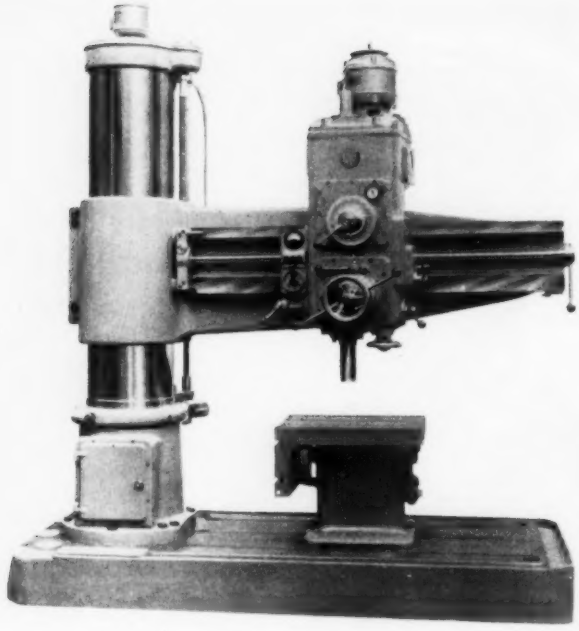
Today, though his achievement has been copied and imitated by others, his personal unqualified devotion to accuracy is the exclusive heritage of Ellstrom . . . *now measuring in millionths for three generations.*

ELLSTROM STANDARDS DIVISION

DEARBORN GAGE CO. • 22035 BEECH ST. • DEARBORN, MICH.

Originators of Chromium Plated Gage Blocks





German Radial Drills Use Electro-Hydraulic Clamping

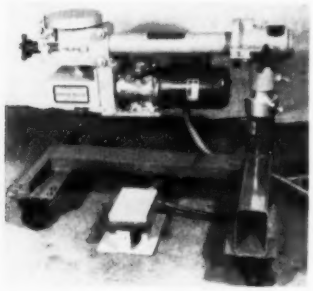
These radial drills have hardened and ground gears sliding on hardened and ground spline shafts rotating on ball bearings. The machines use an electro-hydraulic clamping system for rigid locking (automatically or by hand) of column and spindle head, pushbutton controls, and speed selector, all centrally located on the head.

Auxiliary equipment includes a device for the preselection of feeds for a sequence of rough and finish drilling, reaming, and tapping operations.

The drills have various capacities for drilling cast iron from 1⅜ to 8-in. dia with a maximum drilling radius from 27 to 180 in. Column diameters range from 7½ to a max. of 36 in.

Imported from Germany, the machines are said to be suitable for light, medium, or heavy drilling, with the complete line offering ample ranges of speeds and ranges. Illustrated is the Kolb Model NKR53 with 12 speeds from 30 to 1500 rpm and 12 feeds from 0.003 to 0.118 in. per revolution.

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.



Universal Power Attachment For Welding Positioners

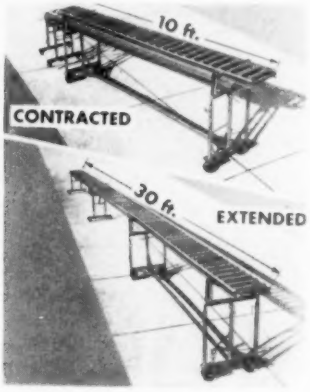
This power attachment has been completely redesigned. It enables the worktable on any of the following positioner models: 14C500, 14C1000, or 14B200 to have motorized rotation.

Features of the power unit are: Infinitely variable speeds from zero to 6 rpm. Quick engage and disengage of the power transmission for power or manual rotation. Worm and worm-gear final drive adjustable to eliminate backlash on the worktable. Friction clutch coupling to allow the operator to position the work on the rotational axis whether table is turning or not. This would be necessary in the event the operator had to quickly tack weld a job at the 0°, 90°, 180°, and 270° positions to prevent warpage prior to making a continuous weld.

The attachment is easily installed—the original worktable spindle-block assembly has only to be taken off and the new unit put in its place.

Standard power characteristic is 110/220 v, single-phase, 60 cycle.

Aronson Machine Co., Arcade, N. Y.



Telescopic Portable Conveyor Is Equipped With Rollers

This roller conveyor supplements the skate-wheel model now being used.

The conveyor is telescopic, easily pushed in or pulled out to follow the load for quick pick-up and delivery. Mounted on heavy casters, it is quickly rolled into position. A break-lock holds the unit in position.

The roller model is supplied in 12 and 18 in. widths. Nine different lengths are available which extend to a max. of 30 ft.

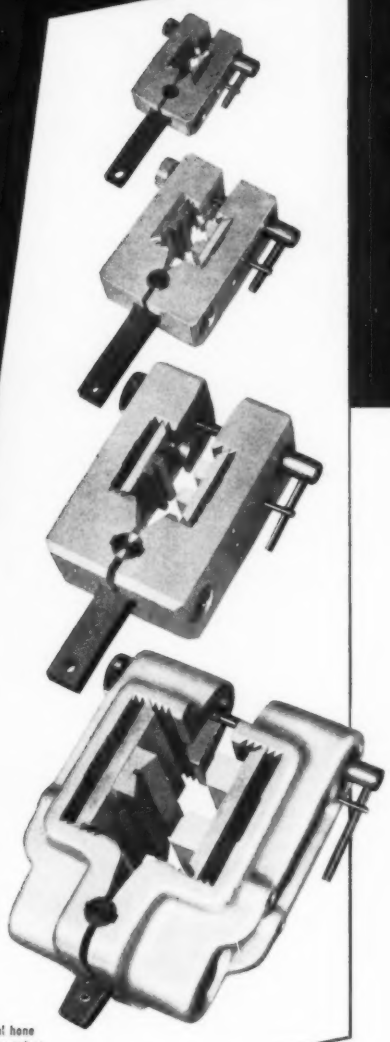
The Wilkie Co., 5520 Arch St., Philadelphia 39, Pa.

Materials-handling boxes can be fabricated of wire up to ⅝ in. max. dia, wire mesh, expanded metal, sheet metal, or any combination of these materials. The baskets can be coated with various plastics and rubber to protect the contents or to resist pickling compounds, solvents, and degreasing solutions. In addition, baskets can be nickel, cadmium, zinc plated, Parkerized, Bonderized, or copper finished.

Coleman-Pettersen Corp., 2106 St. Clair Ave., Cleveland 14, Ohio.

When O.D.'s Have to be Straight and Round,

Use SUNNEN EXTERNAL HONES To Correct Defects



Four external hone sets handle complete range from .120" to 2.750".

For shafts, pins, arbors, gage bars, plungers, metering rods, spindles, valve pistons and similar parts

These new honing tools correct heat treat warpage and waviness—can be used with multiple stone holders to increase the length of the honing surface, to bridge the curvature of the part and produce a straight, round outside surface. And besides correcting such geometric defects as warpage and out-of-roundness, Sunnen External Hones also remove defects in surface finish—for example, centerless grind patterns and tool marks—with minimum stock removal.

Sunnen External Hones are suitable for finishing most types of outside surfaces in a diameter range of .120" to 2.750". They hold dimensional tolerance to .0001" and better; produce surface finish as fine as 2 micro-inches RMS in hardened steel. Speed is many times faster than lapping.

Production, tool room, maintenance, salvage—any or all of these departments may have need for Sunnen External Hones. To find out more about the benefits, mail the coupon for FREE descriptive booklet.

634

TYPICAL APPLICATIONS

Needle Valve Metering Rod Valve Spool Gage Bar

SUNNEN PRODUCTS COMPANY
7925 Manchester Avenue • St. Louis 17, Missouri
Canadian Factory: Chatham, Ontario

To: SUNNEN PRODUCTS CO.
7925 Manchester Ave., St. Louis 17, Mo.

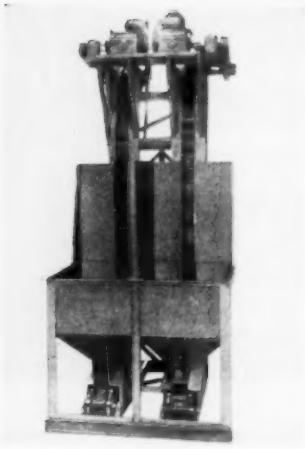
☐ Please send bulletin on external honing. ☐ Have representative call.

Name.....

Company.....

Address.....

City.....Zone.....State.....



May-Fran Conveyor Feeds Parts For Heat-Treating, Cleaning

This feeder unit handles small castings, forgings, stampings, and machined parts during heat-treating, sand-blasting, washing, cleaning, and other operations.

They are custom fabricated from parts to meet individual requirements relative to size and capacity. Shown is a 16-ft high, double-row conveyor which utilizes two 6-in.-wide hinged-steel belts. It can also be used as a hopper storage bin prior to final discharge of parts for processing. Because the conveyor belt itself forms the bottom of the hopper, bridging is eliminated and a continuous flow of parts is assured. The unit recesses into the floor 68 in.

Belt width, height, size of hopper, and choice of floor or recessed hoppers are optional features. A variable-speed drive can be provided for the regulation of parts flowing from one stage to another.

May-Fran Engineering, Inc., 1677 Clarkstone Rd., Cleveland 12, Ohio

Glass-Fiber-Reinforced Plastic Machines Like Brass

This glass-polyester plastic is said to have punching and machining properties similar to brass and yet still retain its characteristic properties.

A sheet, available in 1/8, 3/16, and 1/4 in. thickness, has a tensile strength of 11,900 psi, compressive strength of 14,300, and impact of 10.3. It is chemically resistant to acids, salts, and mild alkalies as well as most organic solvents. Water absorption is 0.39%.

Electrical properties include dielectric strength of 325-v per mil., arc resistance of 120 sec, and power factor of 4.24. Dielectric constant is 4.83 and specific gravity is 1.38.

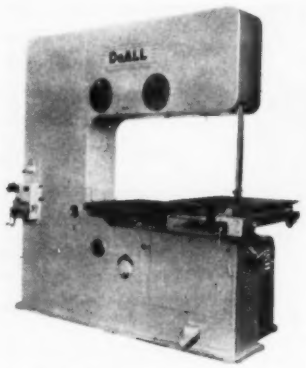
The Dynakon Corp., 5509 Hough Ave., Cleveland, Ohio

Wolverine Toggle Clamp For Heavy Fixtures

This large, push-type toggle clamp has a plunger 1 in. in dia. Stroke is 2½ in. and ultimate load 10,000 lb. Constructed of solid bar stock, they will withstand heavy-duty operation.

The ground plunger and broached guide hole permit accurate locating.

Wolverine Tool Co., 1486 E. Woodbridge, Detroit 7, Mich.



Doall Multi-Purpose Bandsaw

Standard drive and feed components are combined in this 60-in.-throat frame to provide maximum machining versatility.

The welding unit joins and anneals all band widths up to 2 in. It includes a motorized grinder and a blade-squaring shear.

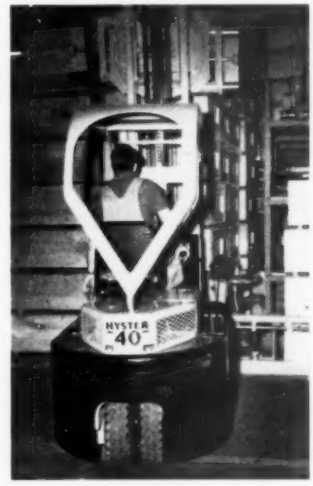
The job selecter dials cover blade, speed, and feed recommendations for all materials over the machine's speed range of 40 to 10,000 fpm. This speed range is handwheel controlled through a three-speed transmission and variable-pitch-dia drive.

For straight power feeding, the 16-in.-stroke hydraulically powered worktable is used. The table can be tilted 45° right, 10° left for angular cuts and beveling operations. The hydraulic-pressure system is built in and feed is regulated by a convenient control at the front of the table.

The upper guide post is adjustable to cover the full 36-in. work height of the machine and a heavy steel guard covers the blade to the point of work. The lower guide post is adjustable. With the auxiliary table removed, the lower guide may be raised above the standard top for ease in manipulating large sheets for contour friction cutting.

The machine uses a 7½-hp motor.

The Doall Co., Des Plaines, Ill.



Fork Lift Truck Has Dual Wheels on Trunnion

These Model YT-40 (4000-lb capacity) fork lift trucks are being equipped with dual instead of single wheels on the steering trunnion. Present Model 40's can be easily converted. Tire changing is accomplished by removing one lock stud.

The new model also has reduced the gear ratio in the steering mechanism from 31 to 1 to 20.7 to 1, requiring only seven turns on the steering wheel to swing the trunnion 120°.

The Model 40 pneumatic-tire size has been reduced to 6.00x9 so that they can be interchanged with tires on the Hyster Model 20 (2000-lb capacity).

Hyster Co., Portland 8, Oregon

Jig feet and rest button line has been added to with 5 new sizes—all carburized, hardened and ground. Full-size templets for tracing purposes are available upon request.

Morton Machine Works, 2421 Wolcott, Ferndale 20, Mich.

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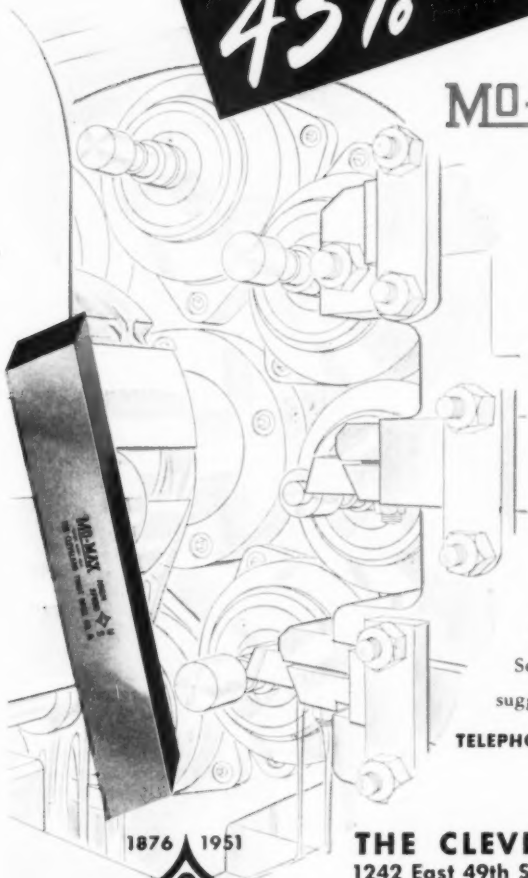
MO-MAX TOOL BITS



On three operations in the set-up pictured here—machining nickel-moly steel (4615) at 135 to 150 s.f.m.—the superintendent kept careful records of tool performance. It was found that MO-MAX COBALT High Speed Ground Tool Bits ran *43% to 100% longer* that the tool bits previously used. ◈ In the break-down operation MO-MAX ran 4 hours, as compared with 2 hours for the other steel. In facing, it was 5 hours against 3½ hours. In cut-off, 4 against 2½. ◈ This is one of hundreds of tests in which both MO-MAX and MO-MAX COBALT Tool Bits have demonstrated their superiority. So if *you* have a difficult machining problem, a *Cleveland* Service Representative will be glad to give helpful suggestions. Contact our nearest Stockroom, or . . .

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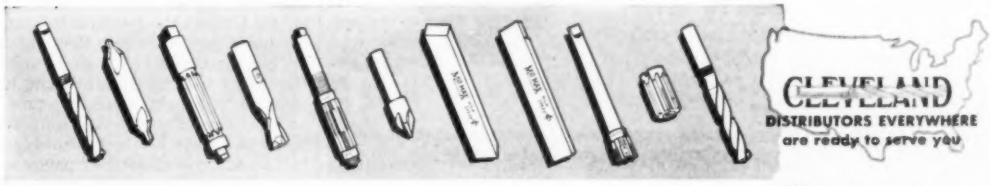

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ROUND TABLE Discussion

PERSISTENT DEBTOR

How far can you go with an employee who persists in accruing debts to a point where garnishee proceedings are taken against him? Should the company offer him financial aid or is this just postponing the inevitable? Some interesting opinions of our readers . . .

To UPHOLD a man who makes no serious effort to help himself is contributing toward his ultimate downfall. This is exactly what Al suggests when he favors the release of a debt in order to keep the man on the staff. A manufacturing plant is created primarily for the production of a certain product and should not be called upon to increase its overhead by acting as a collection agency. A man may occasionally run short of funds to meet emergencies; this is a different situation from the fellow who has no sense of financial responsibility. If one can fling his dollars around indiscriminately, knowing that he can depend on the office to carry him over the tough spot, it's likely to spread among the other fellows. They'll grab onto it as an excuse to get themselves a television set or a more expensive brand of liquor.

The man who borrows from the company does nothing less than hock his future and the company is the sucker in the long run. A firm could create an emergency fund, to be drawn on if the occasion arises, but not being a rubber-stretching Democrat I cannot see the constructive value in it unless the employee contributes to that fund whereby he will create a reserve held to his credit. One might say that if an employee could do this he could handle his own reserve fund. Human nature has been, is now, and always will be, such that this won't work out. If we look at this thing realistically we will see that such an individual as Williams, or others of his kind, hasn't the fortitude to keep his fingers off of any cash that might be lying around. The man is sick. He suffers from lackowillitis and is in need of strong medicine, turnover or no turnover. Anything to ease his malady, such as furnishing him an advance on the easy payment plan, is not only contributing to his own negligence but is doing its share

Eliminate COSTLY SET-UPS!

External grinding spindle on double-end universal wheelhead.

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On the Rivett Model 1024 you can grind holes 1/8" to 9" dia. and plug gauge to 6" depth. A double-end wheelhead swiveling 180° converts this versatile internal grinder to a universal machine—handling internal and external work to 12" dia. and 18" length with equal ability. Toolmen using the 1024 are amazed at the reduction in set-up time.

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WRITE FOR BULLETIN NO. 1024A.

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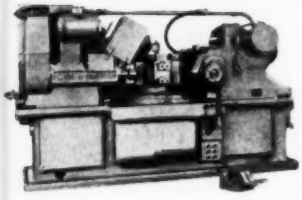

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in disintegrating the foundation of our national economy.

If the man is given a sound talking to and then fails to reform, the kindest thing that can be done is to tie a five-gallon can to his tail and let him gallop down the stairs to the front door.

Jack Everett
San Francisco, Calif.

•

GRUMPY

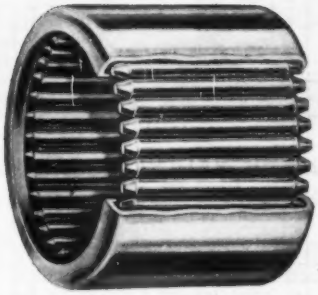
What recourse has Ed in regard to Murphy, the eternal grumbler? Is Murphy's griping tending to break down morale in the shop or is it a natural outlet unharmful in its effect? In Ed's shoes, our readers would . . .

IN MY OPINION, it is the grumblers and gripers in this world who are responsible for more changes for the better than any other source. They are not the type to float along and be smugly satisfied with things as they are. Murphy typifies in my mind the person who is a so-called "grumbler and griper" and yet he has guts and a sense of righteousness which force him to speak on matters which he thinks should be corrected.

Granted that such an individual can make life miserable for management, he can force their attention to things which should be improved whether it be mechanical lifts for chucks or air-foam cushions for stenographer's chairs. The reasons for the continual irritation of the foreman is two-fold. First, and usually most important, the gripe or complaint is expressed in a brief, gruff, or complaining way and at an inopportune time. This, I believe, is what gets most foremen so riled up that they are unable to see the merits of the suggestion or complaint. Secondly, it is usually either something the foreman himself should have thought of but hadn't or else he had not given the matter enough thought to be able to start action. So most gripers and complainers have two strikes against them to begin with and after a half dozen rebuffs or reprimands, they will keep them to themselves or express them only to their fellow workers. But every now and then you will run across a cantankerous rebel such as Murphy who can't be discouraged and will make himself heard regardless of difficulties or animosities and he is the man who will get the improvements made.

Management is too prone to be

...with plenty to spare



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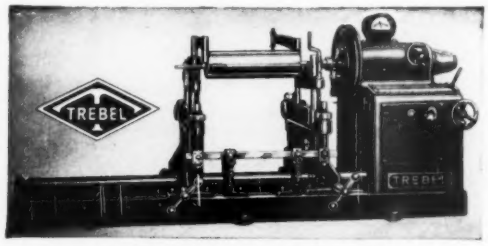

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wrapped in the day-to-day business of getting the job done to give these complaints the consideration they deserve. For each legitimate complaint or gripe there must be a reasonable explanation or a justifiable solution. For each unreasonable complaint there should be an attempt to convince the man of the error in his reasoning or conception. A good foreman makes this part of his job and it will show in the attitude of his men.

R. E. Moulton
Huntington Park, Calif.

•

ALICE IN BLUNDERLAND

I WONDER if management has not come to the conclusion that the foremen have been practicing too much a Blunderland policy in their shops when they find it necessary to organize a Management-Worker Committee?

As a machinist, and later as foreman, I have always reluctantly approached my superiors on personal matters. I have found that they often have little understanding about your own views and that the majority of requests are turned down. I don't therefore think that most of them are not worth considering. The only thing that seemed to have any effect on many foremen was to tell them you were leaving.

Several years ago this was not such a serious threat as it is today, unless it concerned a key man. In the present day shortage of skilled help I think it is a well-founded conclusion to do everything possible to make people stay where they are, and see to it that they are satisfied; this promotes efficiency and the volume of production. But opinion might be divided as to whether this should be carried out by a single

"Sure, Dave, it's impossible, that's why the front office allows you two full weeks to figure out how to do it!"

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Strand

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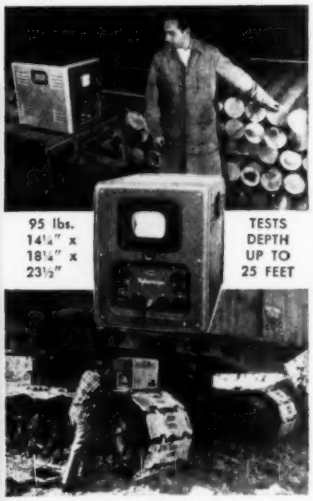

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man or by a committee. Perhaps in the larger factories it is necessary to have a committee.

I don't see why Ed should feel his fur was rubbed the wrong way just because he learned that the management had selected a grievance committee. If management is ready to pay for such a body of men, Ed should accept it without objections—it is none of his business even if it seems foolish from his point of view.

Perhaps the reason for Reynolds going to the committee to get a raise was because Ed went into Blunderland as soon as this question was advanced to him. It's no reflection on Ed that a man wants to make more money. Just think what a relief it is for Ed's prestige to be able to point to the committee as being responsible for the poor returns.

On the other hand, if Ed did want to work out the differences between himself and Reynolds, why didn't he talk to him so that he knew what was going to happen? Every foreman should know his men well enough to be able to tell what's going to happen in his shop.

In days, now gone forever, everybody in the front office supported the foreman no matter what inconveniences he caused a man and his family or how unjust his decisions were. For these reasons I think it is necessary to have a committee or preferably a personnel man to solve the problems involved.

A. E. Fristedt
Stockholm, Sweden

•

GRIEVANCE COMMITTEE

YOU HAVE RAISED the question of the comparative merits of self-imposed cooperation amongst a group of workers as over against the army type of discipline supposedly applied like a coat of paint from the top down.

Fundamentally there are but two types of people: egotists (who become the world's dictators) and altruists (who do the world's work with no thought of personal profit or aggrandizement). Practically most of us are some mixture of the two and how we get along with other people is dependent upon not only our own ability to maintain a fair average between the two extremes in our own living but, also upon the methods of living of those with whom we come into contact from day to day. Egotistical people are always at war with each other whereas altruists can be true partners in a truly cooperative enterprise wherein each person does his fair share of the labor and is

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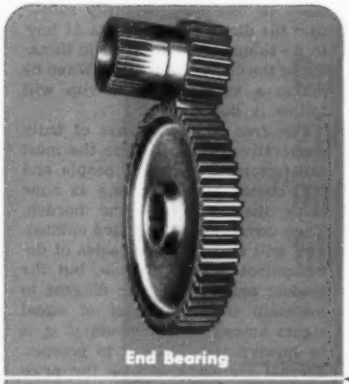
BASIC FACTS ON GEAR TOOTH CROWNING



End Bearing

Elliptoid Tooth Form

Q. Why are gear teeth given the Elliptoid tooth form or crowned?

A. To PREVENT "end bearing" in service.

Q. What is "end bearing"?

A. A concentration of load at the end of the tooth due to end contact between teeth rather than its distribution along the entire tooth face —the condition for which the tooth was designed.

Q. Why is "end bearing" objectionable?

A. Because it imposes concentrated stresses beyond the fatigue strength of the material at the contact point which may lead to premature failure. It is also an important cause of noisy gear operation.

Q. What is gear tooth crowning?

A. A calculated elliptical reduction in tooth thickness from the point of maximum crown (usually the center) toward both ends. Normally it amounts to .0003" per inch of face width per side, but this is optional depending on service conditions.

Q. Can "end bearing" be avoided by any other method?

A. No. Because

1. It is practically impossible to assure perfect alignment under all conditions of loading due to unavoidable deflections in shafts, bearings and the mountings, all of which are elastic.

2. It is also impracticable to avoid all fire distortion in hardening gears which have been machined previously.

Q. How are gear teeth crowned?

A. On Red Ring Shaving Machines.

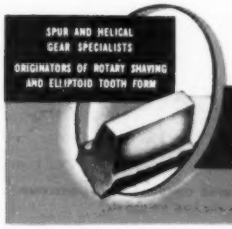
Q. Can the amount of crown be controlled accurately?

A. Positively. Such a large number of leading automotive gear plants would not be using it otherwise.

Crowning is controlled on the Model GCI Shaving Machine by locking the cam which actuates the table movement at the desired point. Models GCU and GCV use formed cutters ground precisely to the amount of crown required. No variation is possible without changing cutters.

In a random check of 4000, 1" face gears the maximum variation in the amount of crown was within the specified tolerance of .0002".

Write for
BULLETIN 549-5
for a more detailed discussion of gear tooth crowning.



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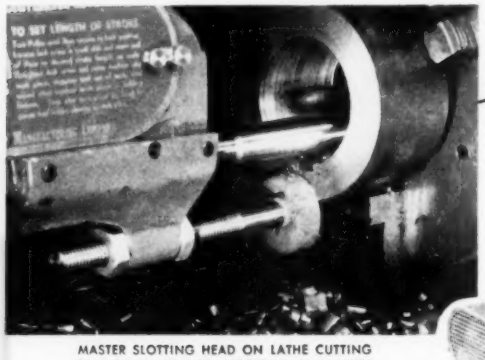
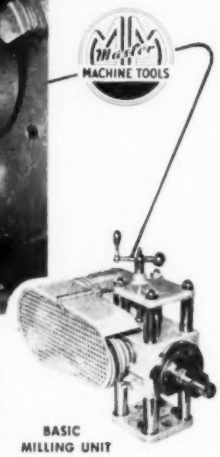


MASTER SLOTTING HEAD ON LATHE CUTTING ½" KEYWAY IN STEEL SLEEVE IN 4½ MINUTES



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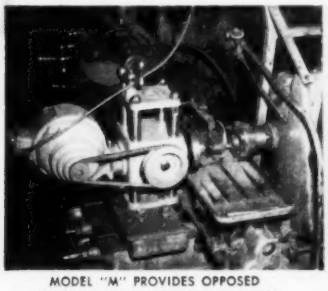
The Master attachments can be used profitably on many production operations. The basic milling unit with the many types of precision heads gives you facilities for milling, grinding, boring, drilling, indexing, slotting, and keyseating. They are an outstanding value for general purpose use in maintenance, repair, tool room, and experimental shops, as well as production, thus providing equipment that performs a full range of shop operations at a minimum investment. Investigate this valuable shop tool, illustrated in new catalog. Three sizes: Model "C," ⅓ hp — 9" to 13" lathes; Model "B," ½ or ¾ hp — 13" to 18" lathes; Model "M," 1 or 1½ hp — 18" to 72" lathes.



MODEL "M" PROVIDES OPPOSED MILLING HEAD ON HORIZONTAL MILL

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fully satisfied with a share of the profits that is in proportion to the service rendered.

The leadership of any group of people in any organization for production or distribution of the materials of industry will determine toward which one of the above extremes the whole group will lean. However, the dictators, either in government or business, will not long survive serious errors in knowledge or judgement on the part of the one who heads up the group. A cooperative cannot long endure a lackadaisical attitude on the part of its members or some dictator will take over, who will more or less surreptitiously substitute his dictatorial concepts of how to do things for the altruistic thinking of the original founders. When he makes a mistake the blowup will follow in due course.

The free and easy ways of truly cooperative enterprise are the most satisfactory to the most people and will continue just so long as none shirk their share of the burden. Their combined abilities and enthusiasm will accomplish miracles of development and production, but the leaders must be forever diligent to maintain the true spirit of equal rights among the members if it is to survive and continue to prosper. Eternal vigilance will be the price of freedom whether in business groups of any size or the social groups we call nations.

This vigilance must include making sure that each member holds the mass good as of more importance than individual desires. The latter are characteristics of the egotist and their only good will be their use as spurs to drive the whole

"It was delivered complete with government bureaucrat to see how we use it."

HELLER

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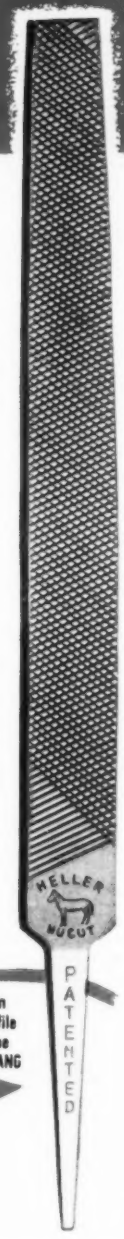

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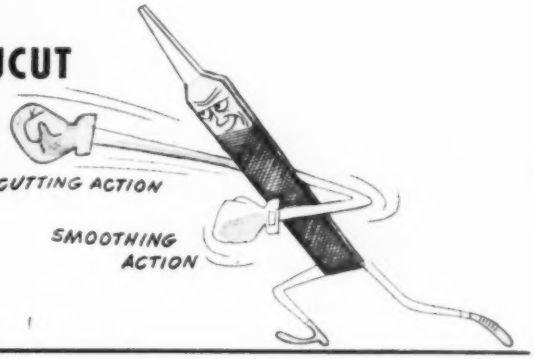

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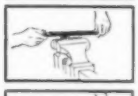
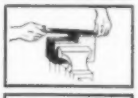
Select right file for job

Files come in many different sizes, shapes, cuts and types. So, make sure you select the right file for the job.

WRONG: Don't use a coarse file on fine work.



RIGHT: Fine work requires a fine file.



WRONG: Don't use a fine file on coarse, heavy work.

RIGHT: Coarse work should be handled with a coarse file.

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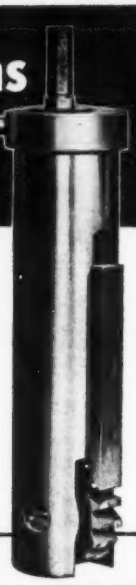

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- for interchangeable parts.
- without clamping the work.
- of standard width and depth.
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group to greater accomplishment for the common good as over against the satisfaction of the individual. This in no wise decries the idea of giving just recompense for unusual ability or enterprise (which is one of the distinctions between cooperation and socialism). It is just as conspicuous as a weakness of dictatorships for them to fail to credit the unusual capacity of underlings as for cooperatives to do so. It is failure at this point that is most apt to develop the bruise that will eventually become the cancer that will destroy the whole group.

A vacuum dare not develop either in the industry of either group or they will not long survive. Let me repeat that I believe that the greatest good for the greatest number can be had by the free and easy method if proper plans are drawn up and followed. If the planning is the result of group ability it will be all for the good. If the planning evolves around one person then it can soon deteriorate into egotistic and thus dictatorial thinking and action.

Arthur B. Clay
North Canton, Ohio

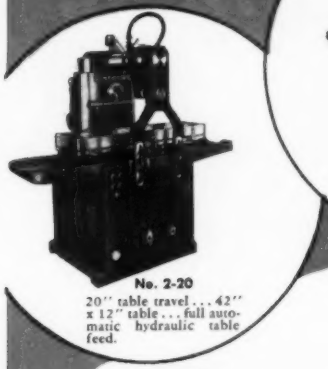
•

THAT a grievance committee is the best way to care for industrial problems is doubtful. What would seem to the writer to be the better way would be for the complainants to first make their grievance known to the individual who directs their work. If their discussion of the matter does not bring about satisfactory results for the claimant, then this individual should feel free to present the issue to the next higher in authority, and so on up the line of executives until a solution is reached satisfactory to the complainant.

Whenever the worker becomes dissatisfied with conditions, such feelings should not be nursed nor the person kept from relieving his mind by giving voice to his feelings to the one that is most likely to understand the situation. The higher-up should do what can be done or give reasons for not doing so.

With such a plan thoroughly understood, it shouldn't produce hard feelings, but would bring the matter to the attention of all concerned and would end the matter. It would leave the complainant with a clear understanding of the outcome and if the decision was not satisfactory, employment elsewhere could be sought without animosity.

H. B. Martin
Watervliet, N. Y.



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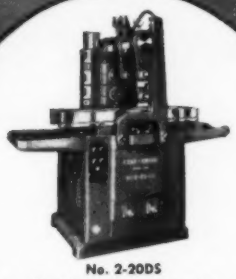

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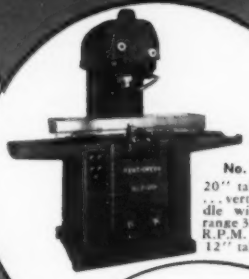

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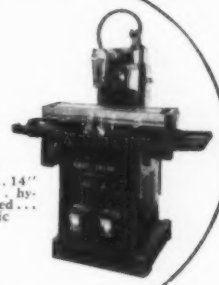

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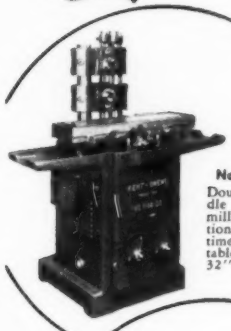

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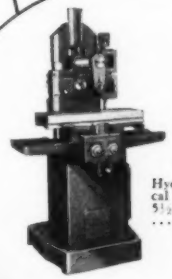

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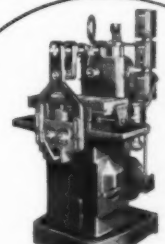

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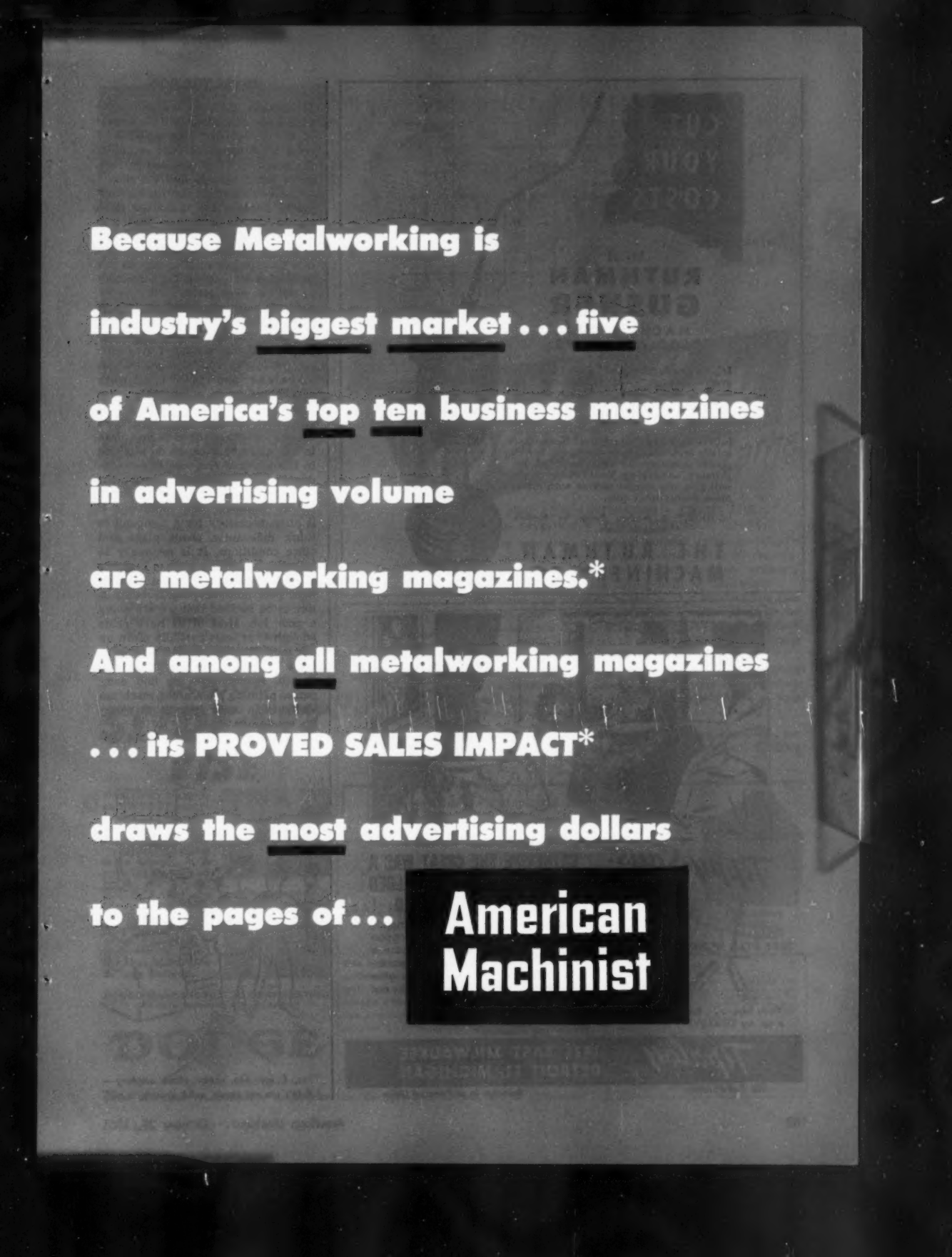
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SPARE THE ROD

IT APPEARS that Al and Ed have mixed two conditions in their friendly discussion: first, the question of good working conditions; secondly, the question of allowing rest periods, extra lunch periods and the like.

The two are often thrown together partly because the unionized mass would like to have them that way and partly because industry has not taken the time to break them down into their proper relationship. In this discussion let us look for a moment at the two separately.

Good working conditions. What actually goes into this to make it a desirable feature for both the employee and the company? Any person with average intelligence realizes that a clear and unobstructed work area helps to do a job better. Yet how many of us, even top supervisory level, work in a cluttered work area . . . whether the area be a desk in the office or a bench or machine in the plant. If the area is not conducive to fast economical work the cost of labor is higher than it should be. To improve such conditions it is often necessary for a company to think differently about plant and office conditions. It is necessary to establish a painting cycle to keep the shop area in condition and to highlight poor housekeeping. None of us like to be notified that we are doing a poor job. Most of us have pride enough to at least partially clean up our mess when conditions around us show it up like the proverbial sore thumb. Accordingly we find companies painting plant areas, machines and such in order to improve working conditions.

Yet painting is only one of the

"Yes, I saw the notice about smoking — I didn't see you comin' quick enough, is all!"

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Every Dodge Slide-Set Vise you install in your plant has a tremendous money-saving potential. Figure it out yourself:

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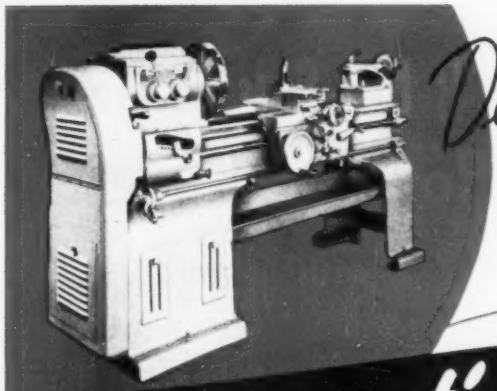

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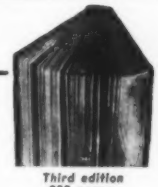

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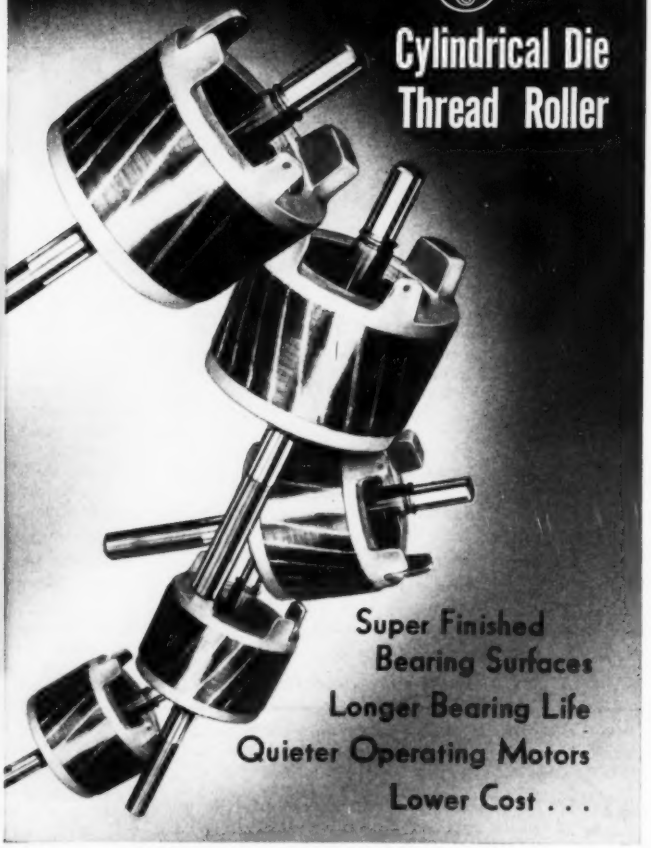

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items in improving working conditions. Another is safety. Why safety? It ties very closely to improved output and lower cost of operation. It protects the employee and aids the employer to reduce the cost of insurance coverage. Many thousands are spent each year for high accident rates. Other thousands are spent on studying and improving safety devices to protect the worker.

Why safety devices? That sometimes really becomes a question, particularly when with the most modern and best of safety-equipped machinery a man or woman loses a finger or a hand. It seems to be that urge which each of us has to take chances. We get away with it once and somehow we always feel that we can again . . . but the machine is so often faster than we are and a machine does not recognize whether it is a piece of steel or a bit of human flesh that it works on. Education does not and will never offset this human tendency to grab pieces of material in a punch press or other machine that is badly centered or that will in some way spoil our work and attempt to rectify the mistake. The usual explanation of this type of accident is the so-called mental lapse of workmen. Many industries spend large sums of money to try to combat these conditions and thereby improve the employees' working conditions.

Let us look for a moment at the other side of the problem. This side is all the items that affect humans tangibly and are therefore often thought of as working conditions. Rest periods usually head the list. If the shop or department is on incentive then into each rate is woven the necessary time elements for personal fatigue and personal time required. If the operator is working on standard and desires to make more than the normal established rate he must naturally work harder than normal. He gets paid for this. The amount for this extra effort is established by the company policy. So also is the allowance for fatigue and personal time. However, these have become standardized except under special conditions. Usually an allowance of ten to fifteen percent fatigue and five to ten percent personal time are used. So as we look at the picture we see that our employees are given time to rest whether they work at a normal rate or whether they work harder and earn a bonus. Now when men exceed a normal bonus level in a plant usually one of two things is happening. Either he is not taking his allowed rest time or he is an exceptional operator and has discov-

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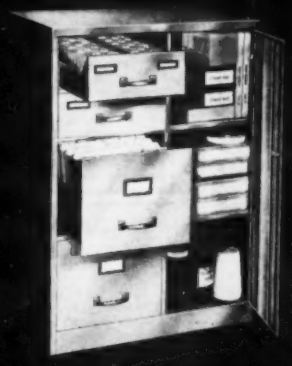

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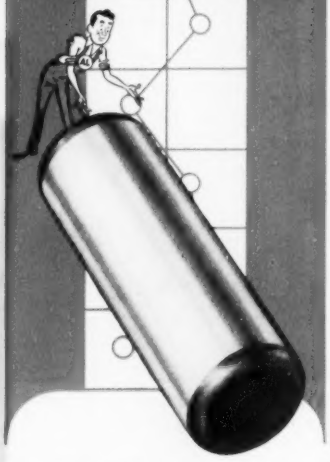

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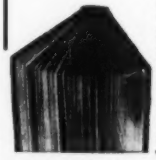

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ered some easier way to do the work.

So why should a company allow extra rest periods? To what avail? Because all work is not on incentive? What prevents the day-rate worker from taking his needed rest? Certainly it is only the foreman who supervises the labor. How can rest periods give rest to employees who do not require rest and who have already rested? No, this means a waste of manufacturing time and adds to the costs of company operations. The benefits are very slight. True once in effect the removal of such rights becomes difficult and frequently causes trouble which results in slowdowns.

Extra lunch periods is another feature which too often is called improved working conditions. Like rest periods they are frills. They extend over the set times. Lost hours of production due to rest periods and extra lunch periods run into considerable money over a year's time. Many companies have learned this too late and frequently due to existing conditions are forced to continue this type of operation. No extra production ever results from these two features. Proper allowances for fatigue and personal time in the wage rate structure is all that any company needs for the tangible effect upon the worker.

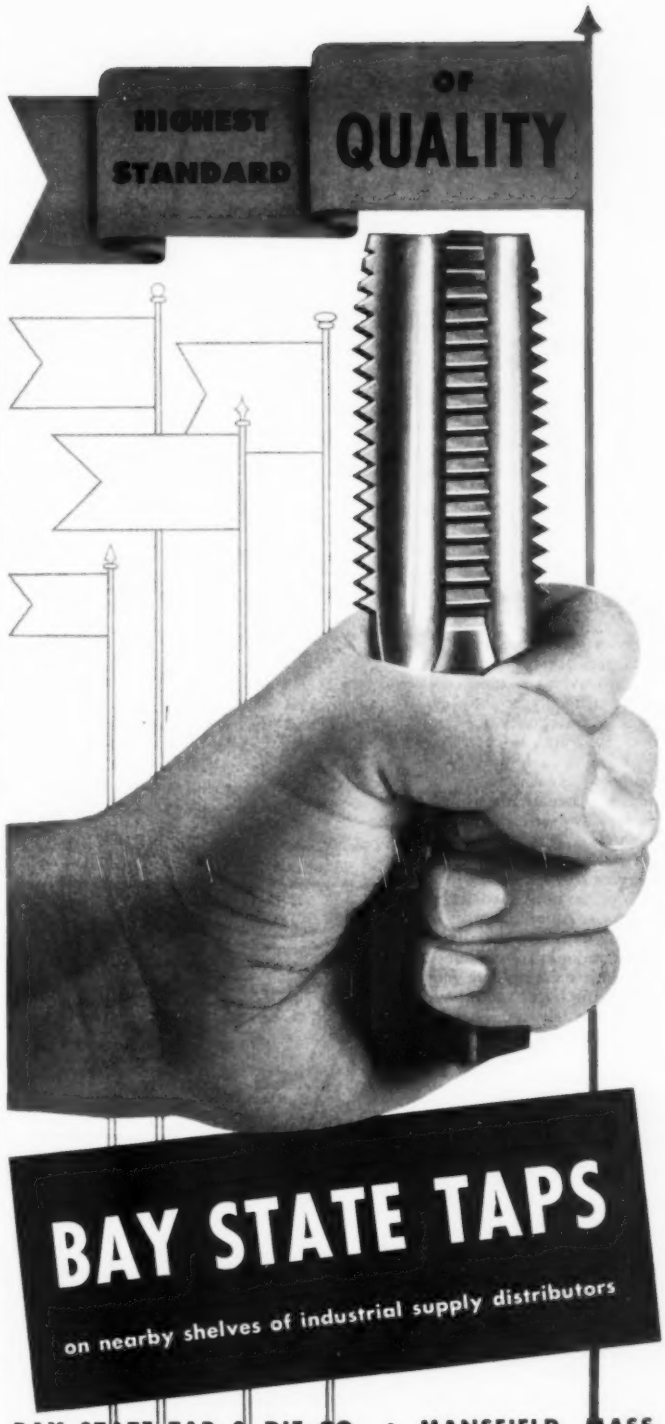
To sum up. Improve shop conditions, pay the worker for the job he does, give him a paid vacation but do not give him extra lunch periods, extended rest periods unless you are willing to take a reduction in actual output over the period and set time.

Charles C. Townsend
W. Hartford, Conn.

•

SEEKING AFTER the soft and easy way of life is no new thing; it is as old as Adam. In the writer's youth and later, it was recognized for what it was and still is—laziness. In those earlier days of lean employment a stern warning was usually sufficient to bring the easy goers to their senses, the real hard shellbacks, however, who were determined not to give a good day's work in any circumstances, were fired, not appeased as now.

During a long and comprehensive executive experience in a considerable number of engineering shops employing men and women, it is my conviction that easy going management never could boast of high production. The rank and file take their cue from the responsible executives, if *they* are goers the *men* are likely to be goers since, if they are not, in the best sense of the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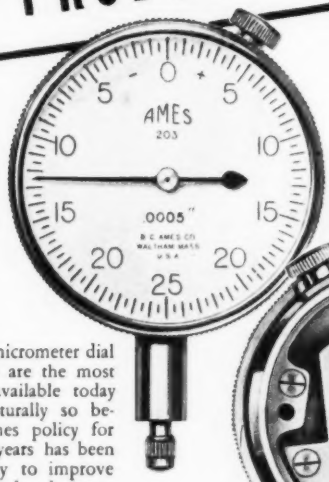

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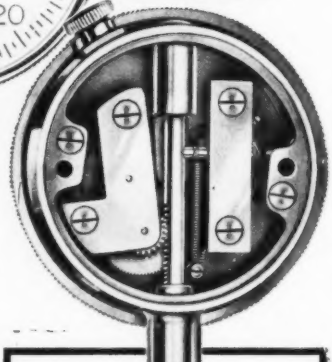

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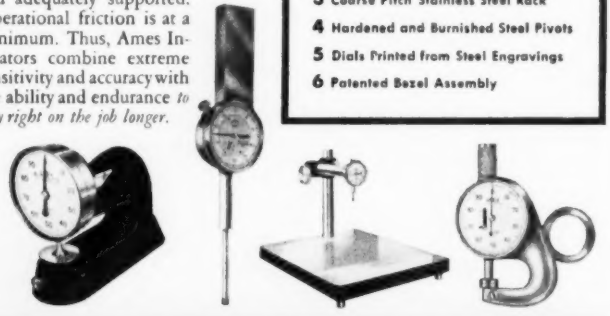

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idiom, sooner or later they are sure to be, in the less agreeable sense! Performance usually lags behind promise in easy going shops and I am not aware that the quality of the product is in any way superior to that of more energetic management. To talk of fatigue, calling for rest periods and refreshment, is rather a joke today, with eight hour shifts, modern shops and labor-saving devices. No healthy person will come to any harm working forty hours per week in such conditions and any who, in the circumstances, cannot give a good account of themselves should see a doctor. To those who enjoy being pampered the introduction of folderols will only suggest that their health is under par and then such morale as they do possess will begin to sag and output to drop.

Industry is so diverse that one standard of working conditions cannot be devised for all works, the heavy forge cannot be fairly compared with the deluxe factory making, say magnetos, the shipbuilding yard with the sewing machine factory nor the heavy rolling mill with the precision instrument plant. In the heavy industries rest periods and refreshments, notably in hot summer weather, are a vital necessity, in general, the nature of such work lends itself to spells off and production does not thereby suffer. In this connection it is noteworthy that here in Britain, trouble over working conditions is almost unknown in the heavy trades. Picture a tea trolley and a radio set on the staging of a liner's hull to refresh the riveters and save them from boredom! They wouldn't know the meaning of the word. Despite the hazardous nature of the work, they put up excellent performances, practice safety last rather than safety first and are confirmed believers in payment by results.

Make it possible for a worker, really prepared to put his back into it, to double his time rate and you can cut the coddling. Admittedly, in some industries piecework is difficult to operate but if the money spent in folderols was spent on devising some form of piecework for all industries and grades, workers would feel much happier and would be prepared to work longer hours if necessary. With all the amenities, short hours, coddling etc., they are definitely no happier or contented today, working on a time rate, than hitherto. Where sound payment by results is in force, labor trouble is practically unknown. Working con-

Continued on p. 198

Want GM Subcontracts? List of Jobs at 39 Plants Aids Suppliers

DETROIT—Want a slice of General Motors' subcontracting pie? One way is to know where to go, which line to stand in for the particular piece you're after. GM has just put up signs directing you to the right line: a new booklet, "Selling to GM," designed to further improve liaison between GM and present and potential suppliers, and to help suppliers find new outlets for their products and services.

Thirty-nine GM manufacturing divisions are listed, with a detailed listing of civilian and defense products made by each. Suppliers can then contact the purchasing departments of the divisions or plants they wish to serve. Suppliers still in doubt about where to write are advised to get in touch with a new central clearinghouse for supplier information by writing the GM Procurement and Schedules Dept., Room 14-262, General Motors Bldg., Detroit.

• **GM has more than 12,000 suppliers** in peace time, and had some 19,000 suppliers during World War II. Today approximately 2000 suppliers furnish materials and parts to help Cadillac build the T41E1 Walker Bulldog tank in Cleveland. Allison Div. at Indianapolis holds prime contracts for turbo-jet and turbo-prop aircraft engines and automatic transmissions for tanks and other tracked vehicles. Aiding Allison in these programs are 25 other GM divisions and 3147 outside subcontractors and suppliers. The latter are scattered over 29 states, and 1800 of them employ fewer than 500 persons.

• **Defense items produced** by the 39 GM manufacturing divisions are listed here. Suppliers can contact purchasing departments of the plants they wish to serve at the addresses given:

AC SPARK PLUG DIV., 1300 N. Dort Highway, Flint 2, Mich.—spark plugs; fire control systems; tank and truck instruments and panels; aircraft gunsights; polar converter units for computers; service parts.

AC SPARK PLUG DIV., 1925 E. Kenilworth Pl., Milwaukee—aircraft computers; aircraft gun and bomb sights.

AEROPRODUCTS DIV., Municipal Airport, Box 1047, Dayton 1, Ohio—aircraft propellers; hydraulic actuators; electro-mechanical actuators; aircraft engine controls.

ALLISON DIV., 4700 W. 10th St. or Box 894, Indianapolis 6, Ind.—turbo-prop and turbo-jet aircraft engines; transmissions and power trains for tanks, cargo carriers, troop carriers and other heavy ordnance vehicles; bearings for aircraft engines, tank engines, and tank transmissions.

BROWN-LIPE-CHAPIN DIV., 700 Marcellus St., Syracuse 1, N.Y.—compressor stator blade carrier assemblies; turbine stator blades for Sapphire jet engine.

BUICK MOTOR DIV., 1051 E. Hamilton Ave., Flint 2, Mich.—Sapphire jet engines; tank cross-drive transmissions.

BUICK-OLDSMOBILE-PONTIAC ASSEMBLY DIV., General Motors Bldg., 3044 W. Grand Blvd., Detroit.—Thunderjet aircraft.

CADILLAC MOTOR CAR DIV., 2860 Clark Ave., Detroit 32, Mich.—tank transmission parts.

CADILLAC MOTOR CAR DIV., Cleveland Tank Plant, 6200 Riverside Drive, Cleveland 11—light tanks; twin gun carriages.

CENTRAL FOUNDRY DIV., 37 Florence St., Saginaw, Mich.—malleable and Armasteel castings for trucks, tanks, diesel engines, guns and ammunition; grey iron castings for trucks, diesel engines, ammunition and tanks.

CHEVROLET MOTOR DIV., General Motors Bldg., 3044 W. Grand Blvd., Detroit 2—Wright R-3350 aircraft engines; 105mm shells; 6x6 military truck components; cross-drive transmission drives; tank final drive assemblies.

(Continued on Page 191)

2000 suppliers help Cadillac build the Bulldog tank

Courtesy: General Motors Corp.

Willys-Overland to Help Ford Produce Jeeps in Canada

TOLEDO, Ohio—Willys-Overland Motors, Inc., has entered into a three-way co-operative agreement with the Canadian Government and Ford Motor Co. of Canada, Ltd., to produce in Canada, quarter-ton 4x4 military trucks having the same specifications as the Willys "Jeep."

Under the agreement Willys-Overland will assist Ford of Canada to tool up for production by furnishing blueprints, engineering information, technical assistance, and the right to use Willys patents.

Willys will also supply parts for the asembly of the vehicles from its sources in the United States until such time as Ford can establish Canadian facilities for makng these parts. The agreement provides for Willys to receive a specified remuneration per vehicle built.

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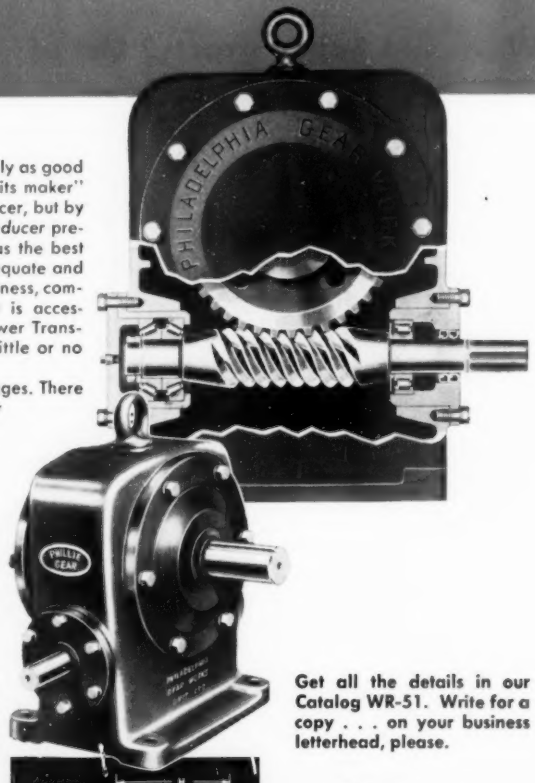

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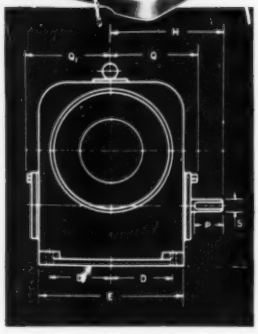

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DELCO APPLIANCE DIV., 391 Lyell Ave., Rochester 1, N.Y.—synchro and torque motors; precision-synchro motors; servo motors; permanent magnet motors; magnetic particle clutches.

DELCO PRODUCTS DIV., 329 E. First St., Dayton 1—aircraft landing gear struts; starter-generators for power generators; tank and truck shock absorbers; helicopter blade tapers; airplane pump motors; gyro motors; oil pumps.

DELCO RADIO DIV., 1446 Home Ave., Kokomo, Ind.—radio transmitter-receivers; electronic equipment.

DELCO REMY DIV., 2401 Columbus Ave. at 24th, Anderson, Ind.—starting, lighting and ignition equipment for tank and truck engines.

DETROIT DIESEL ENGINE DIV., 13400 W. Outer Drive, Detroit 28—diesel engines, 2-cycle, 20 hp to 800 hp; power generator sets, aircooled, single cylinder, gasoline auxiliary.

DETROIT TRANSMISSION DIV., 5140 Riopelle St., Detroit 11—Hydra-Matic transmissions for tanks; Hydra-Matic transmissions and gear boxes for 2½ tons 6x6 military trucks; parts and assemblies for Wright R-1300 trainer-plane engines.

DIESEL EQUIPMENT DIV., 2100 Burlingame Ave., S.W., Grand Rapids 1, Mich.—fuel nozzles and fuel systems for turbo-jet and turbo-prop aircraft engines.

ELECTRO-MOTIVE DIV., 9301 Fifty-fifth St., LaGrange, Ill.—diesel locomotives.

FABRICAST DIV., Third & Monon Sts., P.O. Box 271, Bedford, Ind.—aluminum castings—tank transmission cases, torque converter elements, jet-aircraft engine parts, distributor housing generator and frames, engine pistons, blower rotors; ferrous castings—cylinder liners with bonded-aluminum muff.

FISHER BODY DIV., General Motors Bldg., 3044 W. Grand Blvd., Detroit 2—aircraft jigs and fixtures; medium tanks and spare parts; airplane sections and spare parts.

FRIGIDAIRE DIV., 300 Taylor St., Dayton 1—propeller blade assemblies; hub assemblies; aircraft component parts; Bendix jet engine fuel controls; fan impeller assemblies for auxiliary gasoline engines.

GMC TRUCK & COACH DIV., 660 South Blvd., East, Pontiac 11, Mich.—2½ ton 6x6 military trucks; GMC civilian type trucks for various government agencies; GMC coaches (33 passenger intercity, gasoline powered).

GENERAL MOTORS OF CANADA, LTD., William St., East, Oshawa, Ontario—GMC type 2½-ton 6x6 military trucks.

GUIDE LAMP DIV., 1637 West 25th St., Anderson, Ind.—lamps—head, tail, marker, warning, width marker, panel, spot, indicator, dome; reflex reflectors; sealed units.

HARRISON RADIATOR DIV., Washburn St. at Walnut, Lockport, N.Y.—engine cooling radiators for tanks and trucks; engine and transmission oil coolers for tanks and trucks; heat exchangers for diesel engines, generators, motors and electronic devices; aircraft cabin coolers; aircraft engine, transmission and hydraulic oil coolers; Sapphire jet engine combustion chamber assemblies.

HYATT BEARINGS DIV., 427 Middlesex St., Harrison, N.J.—roller bearings; junior roller assemblies; Hyatt roller bearings for diesel locomotive traction motors; railroad journal boxes.

INLAND MANUFACTURING DIV., 2727 Inland Ave., Dayton 1, Ohio—tank tracks; seals (molded and extruded); steering wheels; truck clutches; hydraulic brake hose; misc. synthetic, plastic and rubber molded parts for trucks.

McKINNIN INDUSTRIES, LTD., Ontario St., St. Catherines, Ontario—front, intermediate and rear axles for 2½-ton 6x6 military trucks.

MORAINE PRODUCTS DIV., 1420 Wisconsin Blvd., Dayton 1—automatic transmission clutch plates and parts; engine bearings; hydraulic brake controls; powder metal parts; rolled bronze products; metal filter and flame arrester media.

NEW DEPARTURE DIV., 269 N. Main St., Bristol, Conn.—ball bearings; forgings.

OLDSMOBILE DIV., 1014 Townsend St., Lansing, Mich.—3.5-in. rockets; 90-mm guns; Sapphire jet engine compressor and turbine units; tank and aircraft forgings.

PACKARD ELECTRIC DIV., 305-541 Dana St., N.E., Warren, Ohio—insulated copper and aluminum wire and cable; cable assemblies; wiring assemblies for aircraft, motor vehicles, tanks, Howitzer carriages, bomb sights, tank retrievers, rangs finders, prime movers and other uses.

PONTIAC MOTOR DIV., 196 Oakland Ave., Pontiac 11, Mich.—4.5-in. rockets; 40-mm Bofors-type cannon; amphibious cargo carriers.

ROCHESTER PRODUCTS DIV., 1000 Lexington Ave., Rochester 3, N. Y.—"Rochester" carburetors for power package engines and military tank-type vehicles; aircraft controls for jet and reciprocating engines, manifold pressure regulators; "GM" steel and Fuse-Kote tubing for military vehicles.

SAGINAW STEERING GEAR DIV., 628 N. Hamilton St., Saginaw, Mich.—steering gears, drag links and Hydra-Matic transmission parts for GMC 2½-ton 6x6 military trucks; operating slide for .30-cal carbines; hydraulic cylinder assemblies for Thunderjet aircraft; parts for fire control systems; ball bearing screws for aircraft; Acme thread screws for aircraft actuators.

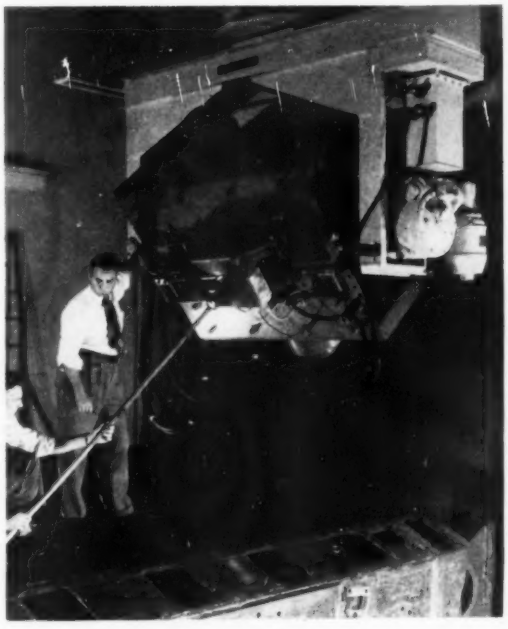
TERNSTEDT DIV., 6307 West Fort St., Detroit 9—tank range finders; gyro units for aircraft compass systems.

Cessna's $80-Million Backlog Mostly Subcontract Work

WICHITA, Kansas—Cessna Aircraft Co., with orders for more than 2000 of its L-19 Birddog Army liaison plane is still deriving the majority of its backlog source from subcontracting for other aircraft manufacturers. Cessna's current backlog stands at $80-million; dollar value of subcontracts has not been disclosed.

Cessna's subcontract orders include; about $16-million from Lockheed for assemblies of aft fuselages and tails of the Lockheed F94 intercepter and T-33 jet trainer at the company's Prospect plant; an undisclosed substantial order for tail assemblies for Boeing's six-jet B-47B to be made at Cessna's Wichita Airport plant; and major components for the Republic F-84F General Motors is building at Kansas City. These parts will be produced at Cessna's enlarged Hutchinson, Kansas plant.

Meanwhile Cessna is continuing production of its commercial four-place Model 170 airplane, with its big brother, the 190 now going to the Army.



A 20-million-volt betatron, used at the E. Chicago, Ind. plant of Allis - Chalmers, can detect flaws as small as 0.02 in. in castings, forgings, and weldments up to 24-in. thick. It can examine sections 20 ft in length

Supreme brand chucks are comparatively new in the field (2 years) but are made by experienced manufacturers of precision assemblies. They have proved their *top quality* performance under actual working conditions. Each chuck is factory checked for *accuracy*, assuring that every chuck that reaches the trade is *dependable*. Many portable tool manufacturers are including Supreme brand chucks as part of their original equipment . . . this means they, too, know that Supreme brand chucks are quality chucks.

Supreme brand chucks are available for replacement . . . try them the next time you order.

SOLD THROUGH DISTRIBUTORS

SUPREME BRAND CHUCKS

Supreme Products, Inc., 2222 South Calumet Avenue, Chicago, Illinois

THE CHUCK THAT LIVES UP TO ITS NAME...SUPREME

Subcontractor Clinic Held for N. J. Area

PATERSON, N. J. — The Greater Paterson Chamber of Commerce recently sponsored a three-day experimental clinic and exhibit to aid the 1100 small manufacturers in the area in getting new business through defense subcontracts.

Through the Chamber, those seeking subcontract work were introduced to prime contract exhibitors and they discussed contracts, procurement, and methods of obtaining strategic materials. Procurement officers from the principal purchasing agencies of the Armed Forces in the east, told the small businessmen, what they buy and how, where their facilities might be useful, and whom to see about it.

Work on Armored Carriers

OAKLAND, Calif. — Consolidated Western Steel Corp. has begun production on a $15-million subcontract from Food Machinery & Chemical Corp. for armed personnel-carrier hulls. Full production will come later in the year when two additions to the Oakland plant are completed and about 1000 more workers are added to the plant. The new armored carriers, designated the T-18-EL by Army Ordnance, each accommodate 12 infantrymen and are mounted with a 50-cal machine gun. The carriers will be assembled at the San Jose factory of Food Machinery & Chemical Corp.

Barge Contracts Awarded

WASHINGTON — The Navy has awarded contracts for construction of four 165-ft steel barges to be used by the Air Force to transport gasoline and oil. Albina Engine & Machine Works, Portland, Ore., will build two of the barges and E. W. and A. P. Dupont, Inc., a yard in Morgan City, La., will build the other two.

Subcontractor Shows Slated

WASHINGTON — More Subcontractor exhibits to enable small businessmen to examine military items which they might make under subcontracts are being organized by the Armed Forces Regional Councils, as follows: Detroit, Michigan State Fair Grounds, Oct. 30-Nov. 2; Denver, Colo., Denver Univ. Arena, Nov. 13-15.

Moratorium Halves Grants of Certificates of Necessity

WASHINGTON—The Defense Production Administration has been approving only about half the applications for certificates of necessity since Defense Mobilizer Charles E. Wilson declared a general moratorium on Aug. 18, designed to postpone additional new facilities expansion.

DPA approved 335 certificates since Aug. 18 while turning down 350 applications. DPA explained that the majority of applications approved fall within the first of the five categories listed by Mr. Wilson as exceptions to a moratorium. This first category includes requests for amortization on which certificates must be issued before Sept. 23 in accordance with provisions of the Revenue Act of 1950. The other categories: Requests for amortization of:

2. Facilities urgently required for the production of specific military end items;

3. Facilities urgently required for expansion of critical raw materials;

4. Facilities required to round out urgently needed expansion projects now under way;

5. Facilities which will not require amounts of critical materials in excess of standards recently prescribed by DPA or where the amount of critical materials needed is very small but will result in a substantial contribution to the mobilization effort.

Metalworking facilities approved are listed here. Information is given in this order: name of company, location of facilities, product or service, amount certified, and percentage allowed.

C. O. Hoffacker Co., Cranston, R. I.—machine tools, $7,330; 85%.

Pitney-Bowes, Inc., Stamford, Conn.—aviation parts, $771,770; 75%.

National Store Fronts Co., Inc., Nashua, N.H.—aluminum extrusions, $2,134,990; 75%.

Doelcam Corp., Boston—aircraft instruments, $846,702; 80%.

Niles-Bement-Pond Co., Warwick, R. I.—fuel pumps, aircraft, $371,070; 75%. Also, at West Hartford, Conn.—machine tools, $226,-160; 75%.

Miesel Press Mfg. Co., Boston—aircraft engine parts; 85%.

National Automatic Products Co., Berlin, Conn.—aircraft parts; 80%.

Hartford Electric Steel Corp., Hartford, Conn.—steel castings; 75%.

Van Keuren Co., New Durham, N. H.—gages; 80%.

Raytheon Mfg. Co., Newton, Mass.—engineering services; 75%. Also, at Bedford, Mass.—electronics; 75%.

Peerless Aluminum Foundry Co., Inc., Bridgeport, Conn.—aluminum castings; 75%.

John Bath & Co., Inc., Worcester, Mass.—thread gages, $19,217; 75%. Also, at Grafton, Mass.—ground thread taps; 75%.

Lovejoy Tool Co., Inc., Springfield, Vt.—cutting tools, $21,300; 90%.

Union Twist Drill Co., Athol, Mass.—milling cutters, $2,200,460; 75%.

Blanchard Machine Co., Cambridge, Mass.—grinding machines, $389,400; 80%.

Scoville Mfg. Co., Waterbury, Conn.—military items; 85%.

Cone Automatic Machine Co., Inc., Windsor, Vt.—machine tools, $505,851; 80%.

The Bullard Co., Bridgeport, Conn.—machine tools, $880,782; 75%.

Miniature Precision Bearings, Inc., Keene, N. H.—ball bearings, $49,000; 75%.

Continental Screw Co., New Bedford, Mass.—aircraft parts; 80%.

Atrax Co., Newington, Conn.—carbide cutting tools, $67,460; 80%.

E. D. Jones & Sons Co., Pittsfield, Mass.—military items; 75%.

D. S. Kennedy & Co., Cohasset, Mass.—electronics; 75%.

Plastics Mfrs. Inc., Stamford, Conn.—bushings, $24,398; 90%.

Hartford Machine Screw Co., Windsor, Conn.—cap screws, $73,041; 75%.

Fellows Gear Shaper Co., Springfield, Vt.—gear cutting, $326,810; 80%.

Fairchild Engine & Airplane Corp., Long Island, N. Y.—aircraft equipment; $1,940,000.

Consolidated Machine Tool Corp., Rochester, N. Y.—boring mills, $156,342; 90%.

Kenyon Instruments Co., Inc., Long Island, N. Y.—aircraft parts; 90%.

August W. Holmberg & Co., Inc., New York—dies, tools, jigs; 90%.

Federal Telecommunication Labs, Inc., Belleville, N. J.—military items; 90%.

Automotive Specialty, Brooklyn, N. Y.—military items; 75%.

American Machine & Foundry Co., Buffalo, N. Y.—military items; 75%. Also, at Brooklyn, N. Y.—machine tools; 75%.

Radio Corp. of America, Camden, N. J.—military items; 75%.

GE's Jet Plant Keeps Only 40% of Air Force Dollar

LOCKLAND, Ohio—Of every dollar received by the General Electric Company here from the Air Force for jet engines in the last year 60 cents went to other companies, most of them small businesses. A total of over 4000 suppliers and subcontractors were involved, according to C. W. LaPierre, manager of the GE aircraft gas turbine department. The remaining 40 cents in each dollar went for wages and salaries, benefit plans, research, engineering, replacement of facilities, rents, taxes, dividends, and re-invested earnings.

Metropolitan Tool Works, New York—military items; 85%.

New York Air Brake Co., Watertown, N. Y.—military items, $192,809; 75%.

Lionel Corp., Irvington, N. J.—military items, $800,000; 75%.

McLean Mfg. Co., Inc., Geneva, N. Y.—machine tools, $297,500; 80%.

Ingersoll-Rand Co., Painted Post, N. Y.—compressors & castings, $484,214; 75%.

Standard Tool & Mfg. Co., Arlington, N. J.—electronics; 80%.

J. K. Smit & Sons, Inc., Murray Hill, N. J.—cutting tools, $26,378; 85%.

Airtron, Inc., Linden, N. J.—military items, $43,672; 85%.

A. E. Bausenbach, Inc., Buffalo, N. Y.—aircraft parts; 85%.

Engelberg Huller Co., Inc., Syracuse, N. Y.—aircraft parts; 80%.

Air Associates, Inc., Teterboro, N. J.—aircraft parts; 85%.

Twin Coach Co., Buffalo, N. Y.—aircraft parts; 80%.

LATEST DEFENSE CONTRACTS

ARMY ORDNANCE AWARDS

Tank-Automotive Center, Detroit

J. W. Speaker Corp., Milwaukee—hardware $230,000.

Eagle Mfg. Co., Appleton, Wis.—trailer, pole handling, exceeds $250,000.

Motor Wheel Corp., Lansing, Mich.—tank and combat vehicle parts, exceeds $250,000, $128,576 (2 contracts).

Allen Industries, Inc., Detroit—motor vehicle parts, exceeds $250,000 (2 contracts).

Rock Island Arsenal

Hobart Bros. Co., Troy, Ohio—generator and alternator, $78,790.

Spring Div., Borg-Warner Corp., Bellewood, Ill.—metallic-belt links, $208,650.

Rex Machine & Tool Co., Inc., Winchester, Mass.—carriage assembly, $129,125.

Detroit Ordnance District

Continental Aviation & Engineering Corp., Detroit—tank-automotive spare parts, not furnished.

Stubnitz-Greene Spring Corp., Adrian, Mich.—percussion primer metal parts, not furnished.

Philadelphia Ordnance District

Crown Cork & Seal Co., Baltimore, Md.—gun modification, $99,830; automatic-20mm gun, exceeds $250,000; spare parts, gun, $180,395, (3 contracts).

Bayshore Industries, Elkton, Md.—grenade fuzes, exceeds $250,000.

Pittsburgh Ordnance District

Wald Industries, Inc., Huntingdon, Pa.—rocket trap and spacer assembly, exceeds $250,000.

SIGNAL CORPS AWARDS

SC Procurement Agency, Philadelphia

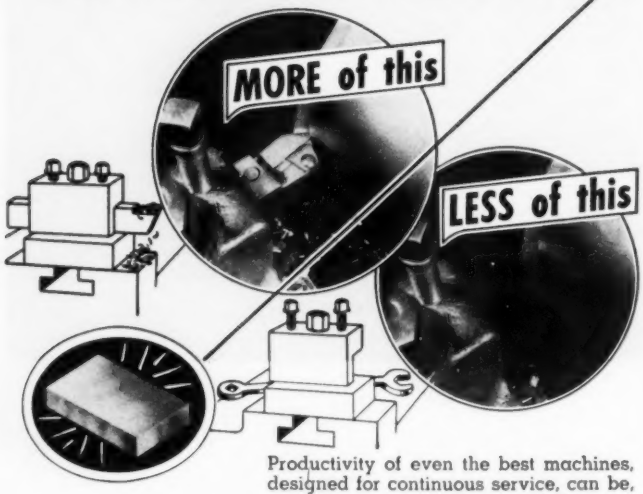
Boonton Radio Corp., Boonton, N. J.—signal generator, exceeds $250,000.

Barker & Williamson, Inc., Upper Darby, Pa.—radio set exceeds $250,000.

Friez Instrument Div., Bendix Aviation Corp., radiosonde receptor, $160,953.

Wilcox Electric Co., Kansas City, Mo.—amplifier, exceeds $250,000.

HOW TO REDUCE "LOST-BUT-PAID-FOR" MACHINE HOURS



Productivity of even the best machines, designed for continuous service, can be, and often is, woefully curtailed by inferior tools that wear rapidly and require frequent shutdown for replacement. Production is thereby recurrently interrupted, *but* costs never cease. Lost time must be paid for.

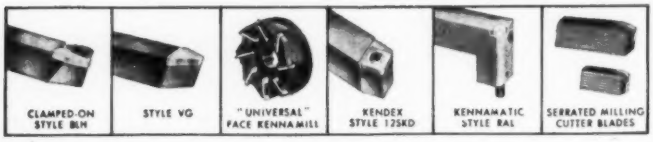
Kennametal tools, on the contrary, have a remarkably long service life. Outstanding durability is inherent. They work more hours per day, spend less time in the grinding room, and thus help reduce idle machine time, make operators more efficient, reduce tool inventory. Superior performance is attained because the physical structure of Kennametal is sound and uniform — the desired properties of hardness, strength, and toughness are consistent.

These outstanding characteristics are achieved through a unique coordination of manufacture and all-inclusive control from raw materials to finished product — refinement of all carbides directly from ores, oxides, and by-products — processing of these carbides into Kennametal compositions by exclusive methods and patented techniques — fabrication of complete tools and wear-part designs that fully utilize the distinctive properties of Kennametal.

For those who wish assistance in developing the most efficient tool applications Kennametal Inc. maintains a corps of competent Field Engineers in all important industrial centers. Their services are available for helping you to reduce lost-but-paid-for machine hours.

KENNAMETAL *Inc.*, Latrobe, Pa.

MANUFACTURERS OF SUPERIOR CEMENTED CARBIDES AND CUTTING TOOLS THAT INCREASE PRODUCTIVITY



Sperry to Produce Guided Missiles for Navy

WASHINGTON—The Sperry Corp., New York, has been awarded a $25 million contract by the Navy to build and operate a guided-missile plant at Bristol, Tenn.

Using materials the Navy already has on hand, the plant will be ready about 15 months after construction starts. Sperry has been designated to select construction contractors with the approval of the Navy.

The plant is expected to employ about 1500 workers and occupy some 350,000 sq ft.

SIGNAL CORPS AWARDS . . . continued

Lockheed Aviation Corp., Burbank, Calif.—maintenance parts, $119,107.

Engineering & Research Corp., Hyattsville, Md.—spare parts, $152,012.

Continental Aviation & Engineering Corp., Detroit—maintenance items, $129,141.

Piasecki Helicopter Corp., Morton, Pa.—maintenance parts, $187,771.

Clifford Mfg. Co., Div. of Standard Thomson Corp., Waltham, Mass.—oil cooler, $144,878.

RCA Victor Div., Radio Corp of America, Harrison, N. J.—production facilities, $248,004.

Highway Trailer Co., Edgerton, Wis.—truck production facilities, $230,000.

Sentinel Radio Corp., Evanston, Ill.—radio set, exceeds $250,000.

NAVY AWARDS

Bureau of Ships Washington 25, D. C.

Marine Mfg. & Supply Co., New Brunswick, N. J.—light-weight anchors, $180,442.

McIntyre Engineering Co., Inc., San Francisco—ventilation heaters, $157,112.

Burton Construction & Shipbuilding Co., Inc., Port Arthur, Texas—barges, $136,200.

Runyan Machine & Boiler Works, Inc., Pensacola, Fla.—barges, $193,800.

Kyle & Co., Fresno, Calif.—covered lighters, exceeds $250,000.

Newport News Shipbuilding & Drydock, Newport News, Va.—aircraft carrier conversion, exceeds $250,000.

Avondale Marine Ways, Westwego, La.—harbor tug, exceeds $250,000.

Albina Engine & Machine Works, Portland, Oregon—gasoline barges, exceeds $250,000.

Portland Tug & Barge Co., Portland, Ore.—barges, exceeds $250,000.

American Blower Corp., Detroit—ventilating blowers, exceeds $250,000.

E. W. & A. P. Dupont, Inc., Morgan City, La.—gasoline barges, $241,600.

Ships Parts Control Center Mechanicsburg, Pa.

Insinger Machine Co., Philadelphia—spare parts, galley equipment, $99,558.

Cleveland Diesel Engine Div., GMC, Cleveland—preserve and pack diesel engine repair parts, exceeds $250,000.

Kerfund Co., Inc., Long Island City, N. Y.—diesel engine repair parts, $82,044.

American Bosch Corp., Springfield, Mass.—diesel engine repair parts, $226,449.

Cummins Engine Co., Inc., Columbus, Ohio—diesel engine repair parts, $136,469.

Ingersoll-Rand Co., Philadelphia—air compressor and steam pump repair parts, exceeds $250,000.

Westinghouse Turbine Division Gets Huge Navy Jet Engine Order

PITTSBURGH—The Navy has recently contracted for delivery of several hundred million dollars of military jet engines from the Aviation Gas Turbine Division, Westinghouse Electric Corp. Included in the order are quantities of the world's most powerful production engine, the Westinghouse J40.

The J40 produces the equivalent of more than 14,000 hp at modern flight speeds, and the addition of an afterburner to reheat the exhaust gases is expected to more than double this figure.

The orders represent the largest equipment purchase for any category of machinery in the company's history.

Several models of the engine are involved, all for use in the latest Navy combat planes. The engines will be built at many of the major plants of the company.

DEFENSE AWARDS . . . continued

Navy Purchasing Office Washington 25, D. C.

General Electric Co., Washington—generators, exceeds $250,000.

Hanson-Van Winkle-Muaning Co., Matawan, N. J.—electroplating machines, $122,054.

National Acme Co., Cleveland, Ohio—chucking machines, hydraulic equipment, exceeds $250,000.

Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.—horizontal-boring and drilling machine, exceeds $250,000.

Lyon Metal Products Inc., Washington—steel shelving, exceeds $250,000.

Landis Tool Co., Waynesboro, Pa.—machine, universal, grinding, $95,994.

Bureau of Ordnance Washington 25, D. C.

E. W. Bliss Co., Canton, Ohio—plant facilities, exceeds $250,000.

Hoover Co., N. Canton, Ohio—production equipment, exceeds $250,000.

Continental Gin Co., Birmingham, Ala.—plant equipment, exceeds $250,000.

Naval Construction Battalion Center, Port Hueneme, Calif.

George Haiss Mfg. Co., Inc., Div. of Pettibone Milliken Corp., Chicago—clamshell buckets, $107,602, $205,959 (2 contracts).

Industrial Brownhoist Corp., Bay City, Mich.—crane, locomotive diesel electric, $142,580.

T. L. Smith Co., Milwaukee—concrete mixers, $165,000, $174,225 (2 contracts).

Ohio Locomotive Crane Co., Bucyrus, Ohio—locomotive, crane diesel, $227,905.

Browning Crane & Shovel Co., Cleveland—locomotive, crane diesel, $228,620.

Trackson Co., Milwaukee—spare parts, $230,000.

Baldwin-Lima-Hamilton Corp., Lima, Ohio—spare parts for crane or crane shovel, exceeds $250,000.

Universal Engineering Corp., Cedar Rapids, Iowa—crushing plant.

Foote Co., Inc., Nunda, N. Y.—paving mixer, exceeds $250,000.

Bucyrus-Erie Co., Milwaukee—crane shovel and parts, exceeds $250,000.

Conveyor Co., Los Angeles—rotary sweeper, exceeds $250,000.

Cleaver-Brooks Co., Milwaukee—distillation unit, exceeds $250,000.

Wayne Mfg. Co., Pomona, Calif.—rotary sweeper, exceeds $250,000.

Manitowoc Engineering Works, Manitowoc, Wis.—crane with parts, exceeds $250,000.

Sicard Industries, Inc., Watertown, N. Y.—snow plow, exceeds $250,000.

Rome Grader Corp., Rome, N. Y.—motor road grader, exceeds $250,000.

Thew Shovel Co., Lorain, Ohio—cranes and parts, exceeds $250,000.

Oshkosh Motor Truck, Inc., Oshkosh, Wis.—snow plow, exceeds $250,000.

Four Wheel Drive Pacific Co., Los Angeles, Calif.—trucks, exceeds $250,000.

Marion Power Shovel Co., Marion, Ohio—cranes and parts, exceeds $250,000.

Northwest Engineering Co., Chicago—crane, crawler, boom, spare parts, exceeds $250,000.

AIR FORCE AWARDS Wright-Patterson AF Base, Dayton

Transducer Corp., Boston—radar training set, exceeds $250,000 (2 contracts).

Western Electric Co., Inc., New York—machinery & equipment for gear components for electronic services, exceeds $250,000.

Kollsman Instrument Co., Elmhurst, N. Y.—indicator, pressure, multi-purpose, $130,573.

Butler Mfg. Co., Kansas City, Mo.—fuel-servicing trailers, exceeds $250,000.

American Gas Accumulator, Elizabeth, N. J. over-run lights, $130,404.

W. L. Maxson Corp., New York—spare parts, exceeds $250,000.

Ryan Industries, Detroit—magazines, aircraft camera, $193,470.

Willys-Overland Motors, Inc., Toledo—facilities for production of aircraft forgings, exceeds $250,000.

Hayes Industries, Inc., Jackson, Mich.—machinery and equipment for production of wheels and brakes, exceeds $250,000.

Briggs Mfg. Co., Detroit—machinery and equipment for B-52 components, exceeds $250,000.

Marlow Pumps, Ridgewood, N. J.—assembly kit and spare parts, $172,893.

Frigidaire Div., GMC, Dayton, Ohio—propeller components and jet-engine fuel controls, exceeds $250,000.

Westinghouse Electric Corp., Dayton, Ohio—generators, exceeds $250,000; alternators, $150,000; synchronous condenser, exceeds $250,000.

Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.—indicator, attitude gyro, exceeds $250,000; automatic pilot components, exceeds $250,000.

Brown & Sharpe Mfg. Co., Providence, R. I.—screw machines, $233,789.

Buick Motor Div., GMC, Flint, Mich.—machinery and equipment for J-65 engines, exceeds $250,000.

Aircraft Div., Kaiser Metals Products, Inc., Bristol, Pa.—machinery and equipment for F-84 and B-47 assemblies, exceeds $250,000.

Tube Turns, Inc., Louisville, Ky.—aircraft forgings, exceeds $250,000.

Titeflex, Inc., Newark, N. J.—ignition system parts, $100,000.

American Products Co., Detroit—machinery and equipment for J-47 components, exceeds $250,000.

Fenn Mfg. Co., Hartford, Conn.—facilities for H-19 helicopters, exceeds $250,000.

Eaton Mfg. Co., Cleveland—machinery and equipment for J-47 components, exceeds $250,000.

Beech Aircraft Corp., Wichita, Kan.—generator sets, exceeds $250,000.

General Electric Co., Johnson City, N. Y.—B-47 armament systems, exceeds $250,000.

Thompson Products, Inc., Cleveland—machinery and equipment, exceeds $250,000.

General Electric Co., Burlington, Vt.—B-47 armament systems, exceeds $250,000.

AC Spark Plug Div., GMC, Flint, Mich.—machinery and equipment, exceeds $250,000.

Fairchild Engine Div., Fairchild Engine & Airplane Corp., Farmingdale, L. I., N. Y.—miscellaneous parts and assemblies, $225,000; static tests, $197,300; power plants, exceeds $250,000.

Sundstrand Machine Tool Co., Rockford, Ill.—special tooling development, exceeds $250,000.

Varo Mfg. Co., Garland, Texas—static converters, exceeds $250,000.

Bendix Products Div., Bendix Aviation Corp., South Bend, Ind.—aircraft sub-assemblies and spare parts, exceeds $250,000; $100,000 (2 contracts).

Kollsman Instrument Corp., Elmhurst, N. Y.—oil pressure indicators, exceeds $250,000.

Friden Calculating Machine Co., San Leandro, Calif.—driftmeters, exceeds $250,000.

Pacific Airmotive Corp., Burbank, Calif.—reconditioning of F51H, $100,000.

AiResearch Mfg. Co., Garrett Corp., Los Angeles—refrigeration turbines, $100,000.

U. S. Gauge Div., Sellersville, Pa.—oil-pressure indicators, exceeds $250,000; torque-pressure indicators, $155,209.

Precision Aeromotive Corp., Houston, Texas—engine overhaul, exceeds $250,000.

Engineering Research Assoc., St. Paul, Minn.—directional gyro indicators, $200,000.

Sunbeam Corp., Chicago—tachometer indicators, $113,682.

Wilcox Electric Co., Inc., Kansas City, Mo.—receivers, transmitters, exceeds $250,000.

Lamar Aero Supply Corp., Clinton, Okla.—modification repairs, $124,800.

General Electric Co., Schenectady, N. Y.—ceramic coating of turbo-superchargers, $113,132; anodic treatment, $167,776; turbo-superchargers, exceeds $250,000.

American Gas Accumulator Co., Elizabeth, N. J.—transformers, exceeds $250,000.

Wm. H. Singleton Co., Inc., Arlington, Va.—plumbing sets, exceeds $250,000.

B. G. Corp., New York—aircraft spark plugs, exceeds $250,000.

Northern Radio Co., Inc., New York—variable master oscillator, frequency-shift keyer, demodulator, $624,336.

Wickes Engineering & Construction Co., Camden, N. J.—mobile communication system, exceeds $250,000.

Stamford Electronics, Stamford, Conn.—signal generator, $220,475.

Ladish Co., Cudahy, Wis.—aircraft forgings, exceeds $250,000.

Bell Aircraft Co., Buffalo, N. Y.—production facilities, exceeds $250,000.

Douglas Aircraft Co., Inc., Tulsa, Okla.—production facilities, exceeds $250,000.

Lockheed Aircraft Corp., Burbank, Calif.—production facilities, exceeds $250,000.

Eclipse Machine Div., Bendix Aviation Corp., Elmira, N. Y.—machinery and equipment, exceeds $250,000.

Kaiser Mfg. Corp., Richmond, Calif.—production facilities B-52 aircraft, exceeds $250,000.

American Stove Co., St. Louis, Mo.—machinery and equipment, exceeds $250,000.

New Departure Div., GMC, Bristol, Conn.—production facilities, propeller bearings, exceeds $250,000.

Thompson Products, Inc., Cleveland—machinery and equipment, exceeds $250,000.

Elastic Stop Nut Corp. of America, Union, N. J.—machinery and equipment, exceeds $250,000.

Fruehauf Trailer Co., Detroit—bomb trailer, $260,000.

Kropp Forge Co., Chicago—aircraft forgings, exceeds $250,000.

Backstand Method Saves Time!

Coan Mfg. Co. triples number of steel guides sanded in one hour

problem: The Coan Mfg. Co., in Madison, Wisconsin, used set-up wheels to sand the beveled edges of a steel guide for vending machines. Using this method they could sand only 10 guides per hour . . . too long and too costly an operation.

solution: The Coan Mfg. Co. switched from the set-up wheel to the backstand belt method for this finishing job.

result: They used an Armour Abrasive Belt and were able to sand 30 guides per hour . . . *tripling production!*

Manufacturers of hundreds of different industrial and consumer items have proved that the backstand belt method is more efficient and more economical than the set-up wheel.

If you are grinding, polishing or finishing flat or contoured surfaces, cast pieces, stamped pieces or forged pieces, the backstand method can help you with your production problems.

To learn more about the many advantages of the backstand belt method, write today for our free booklet.

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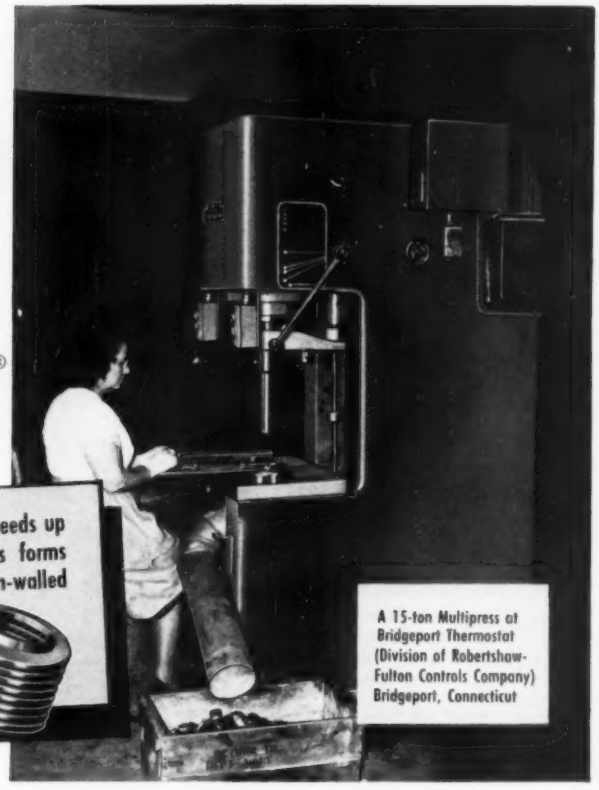
In three drawing stages—at speeds up to 1500 per hour—Multipress forms phosphor bronze discs into thin-walled tubes (left) that later become high-precision bellows (right) for thermostatic controls.



A 15-ton Multipress at Bridgeport Thermostat (Division of Robertshaw-Fulton Controls Company) Bridgeport, Connecticut

"Multipress is also 100% better on set-up and maintenance," says press foreman at Bridgeport Thermostat.

Here's more evidence that deep drawing jobs can be done faster, better and cheaper the Multipress way.

The job here is cupping and drawing phosphor bronze discs into long tubes that are later formed into intricate bellows for thermostatic controls.

With easily adjusted stroke of oil-smooth ram action plus controlled speeds and pressures, Multipress makes it possible to finish the job in fewer stages, at speeds up to 1500 draws per hour. This is 30 to 50 per cent faster than the previous mechanical press method, depending on depth of the draw.

The thin-walled tubes have to be accurate in the highest degree, as the complex folding and corrugating operations that follow must produce bellows that are uniformly sensitive to the slightest temperature changes.

Multipress also makes the operators' job easier, safer, quieter, and more pleasant. A slide feed pushes the part into the press die, and ram action is controlled by footpedal.

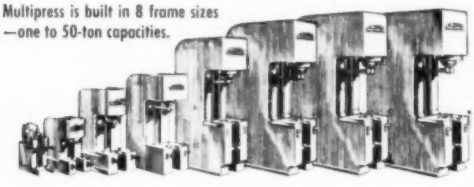
The Multipress, a 15-ton model, handles the job with three-ton pressure, but is also used at higher tonnages, on steel parts, with different tooling. (The dual push buttons are used on some of these job set-ups, where different safety precautions are required.)

The press foreman at Bridgeport Thermostat reports that Multipress cuts maintenance costs and sharply reduces set-up time—not only for the different draws but also in tooling the press for other operations.

Equally important gains are reported day after day by other Multipress users, on jobs that include blanking, forming, crimping, staking, punching, bending, broaching, assembling, and many others.

Multipress is available in a wide range of sizes, as shown below. Index tables; dial feed tables; harmonic stock feeds; attachments for straightening, pelleting, foil marking; and many other standard Multipress accessories are also available. If desired, Denison can design and build tooling, dies, and fixtures to meet your needs. Write today for complete information.

Multipress is built in 8 frame sizes —one to 50-ton capacities.



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ditions, starting time, stopping time, should be the same for all, from the highest exectuive to the humblest helper. Privileges may not spoil good men but what about the others? My great objection to privilege in the individual is that it sows discord and is often the cause of petty jealousies and envy, all of which is bad for team work and high production. Privilege in the mass results are no better, the good show their appreciation by extra effort, the others strive to have the privilege increased. To my mind the best privilege is the privilege of incentive. The privilege of being in a position to decide how much we may earn in a given week stamps us as individuals, lights the flame of competition and clears the way for high individual effort.

C. D. Mackinnon
Lanarkshire, Scotland

NEW BOOKS

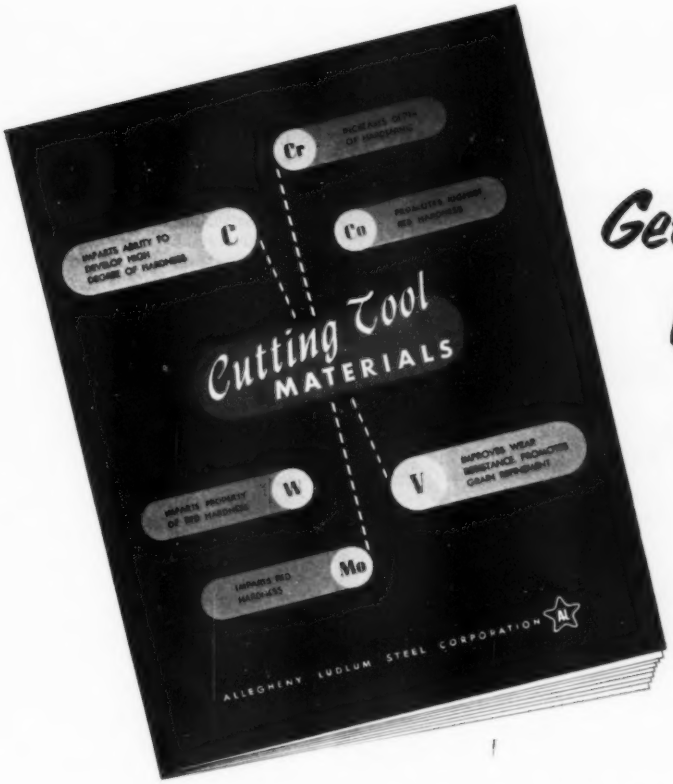
THEORY OF ELASTICITY (2ND EDITION) —*By S. Timoshenko and J. N. Goodier, professors of engrg mechanics, Stanford Univ. Published by the McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, N. Y. 506 pages, 6 x 9 in. Price $9.50.*

Revision and modernization of this popular text. It follows general outline of the original edition, but photoelastic treatment has been expanded to a chapter. Frozen-stress method has been added, as has a chapter on thermal stress and one on solutions of problems of circular and elliptical holes and the like.

•

AUTOMATIC FEEDBACK CONTROL—*By William R. Ahrendt, President, Ahrendt Instrument Co., and John F. Taplin, President, Kendall Controls Co. Published by McGraw-Hill Book Co., 330 W 42nd St., New York 18, N. Y. 407 pages. Price $7.50.*

Feedback is an effect, in electronics, mechanisms, the human nervous system, and in practically any imaginable control system, which sends a signal to the mechanism that controls certain conditions from the location where the conditions exist. feedback systems, including such operation of making this signal affect the mechanism so a given set



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of conditions will be approached. This is the scope of the book: what feedback is, how it works, where it works, and the influences on it.

Because modern instruments and mechanisms allow feedback control, the idea is newly important. It has existed since the human race was created, but only since science has been able partly to duplicate some of the common nervous functions of the human body, that feedback has been found to be an excellent control medium.

For example: Imagine a safe in a room. The safe contains valuable papers, but is not fireproof. The room it is in may burn, but a set of electrical warning devices and controls are installed, connected to a thermostat inside the safe, to trip a sprinkler system in the room. This, roughly, is a feedback system, where conditions inside the safe control conditions outside the safe; which conditions may effect those inside unless they are influenced.

The book covers all manner of feedback systems, including such as servomechanisms, temperature controls, speed governors, electronic devices, hydraulic systems, and the basic theories and devices that feedback control is based upon. There is a section of problems for classroom work, a bibliography, glossary, and an appendix with various mathematical and physical data necessary for use in calculations of problems.

•

CORROSION CAUSES AND PREVENTION (3RD EDITION)—*By Frank N. Speller, D.Sc. Published by McGraw-Hill Book Co. 330 W. 42nd St., New York 18, N. Y. 686 pages. Price $10.*

Already accepted as the standard work on corrosion, this book now goes into its third edition with considerable new material added to bring it completely up to date. It deals principally with the ferrous metals, and explains what corrosion is, the various kinds encountered, and how to prevent it in various fields of engineering work.

The new material in this edition concerns biological influences and cathodic protection, and describes fully the latest advances in practical prevention.

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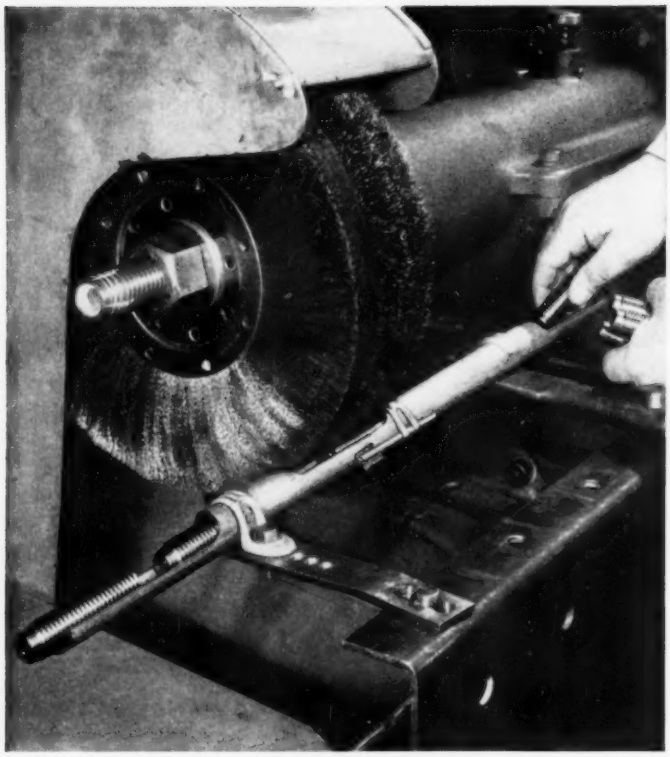

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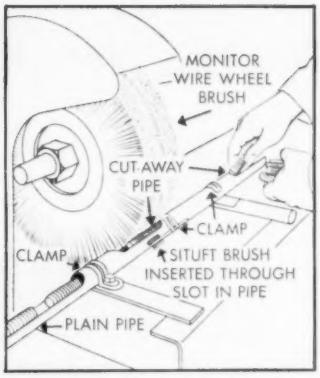
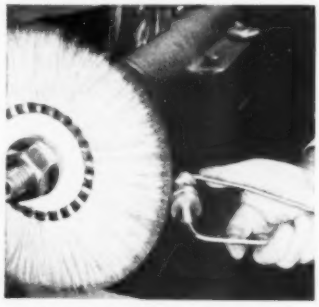
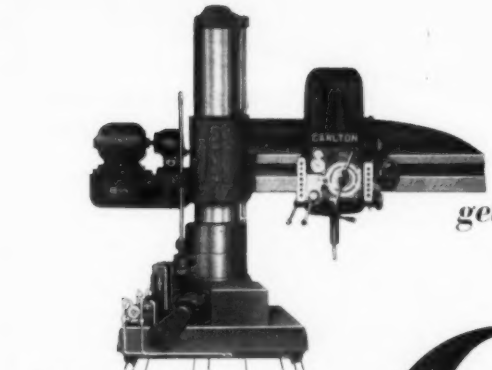


THE FIXTURE. This sketch shows how to make pipe fixture for deburring and polishing small parts, threaded or smooth. Can be made of steel, fiber or plastic tubing.

TYPICAL PARTS. Set screws, pins, pieces of tubing and other parts such as these can be cleaned and finished in the pipe fixture or in the forceps shown below.



ANOTHER SIMPLE APPROACH. For small parts such as bushings, a simple forcep fixture can be devised to hold parts for power brushing. This one is made of wire.



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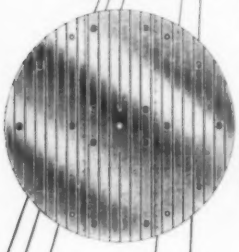
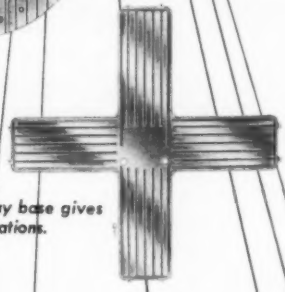
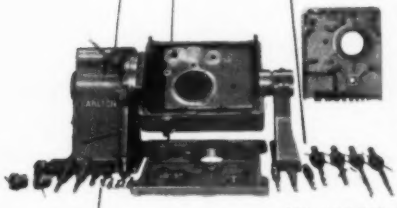


Full round base gives ample space for large work pieces.



4-way base gives four work stations.



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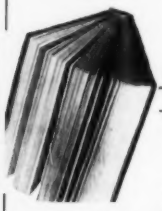

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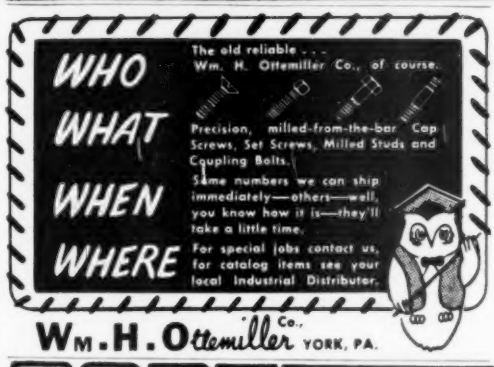
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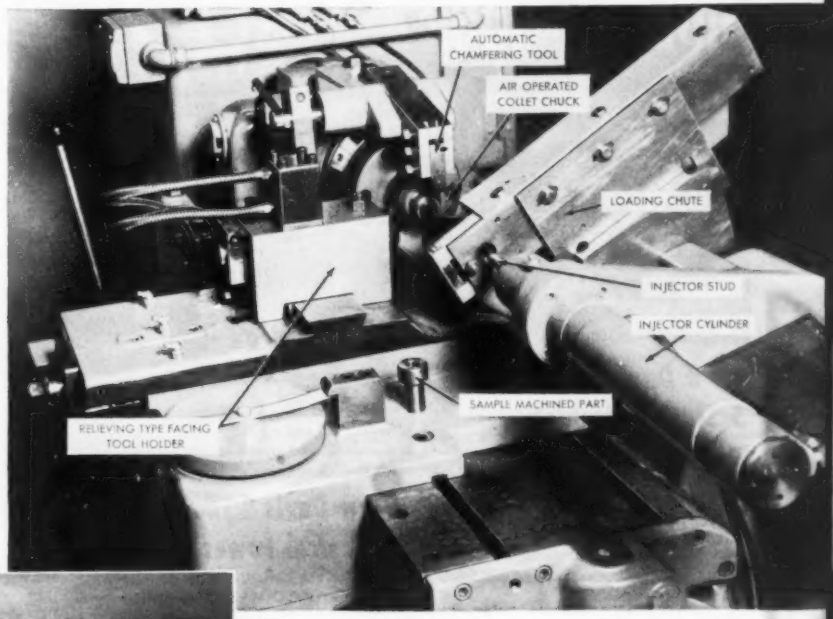

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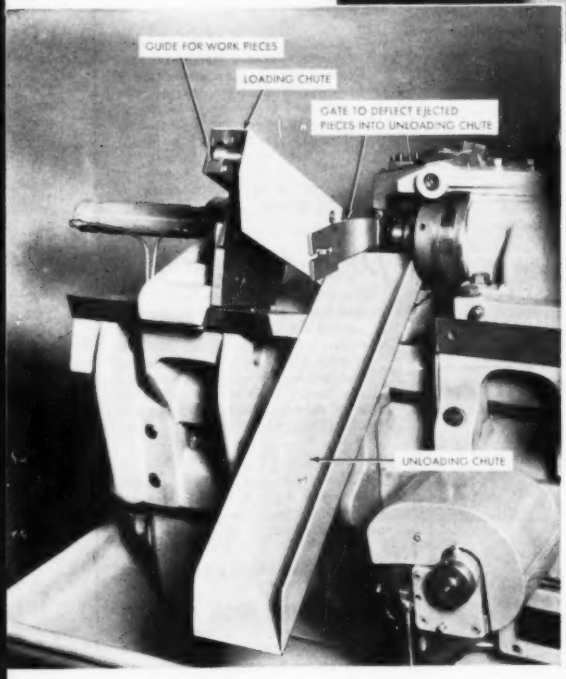

Problem: To finish face and chamfer bore of pump gear true with bearing diameter

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On completion of the machining operation the pump gear is automatically ejected by a plunger located in the bore of the spindle after which the cycle is repeated.

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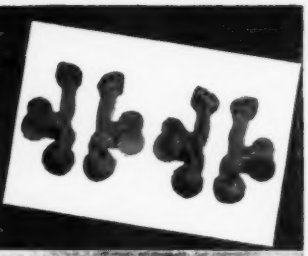

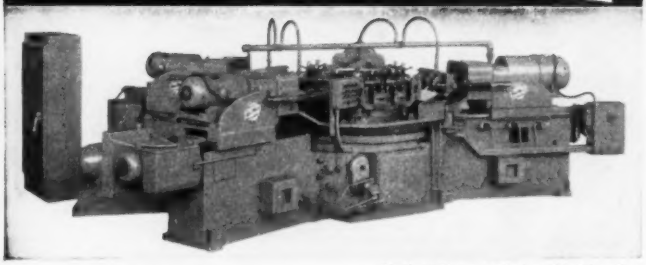

Station Type Indexing Machine for drilling and reaming king pin holes.

On a Davis & Thompson 5 Station Machine

This type MDT FIVE STATION INDEXING DRILLER has five fixtures mounted on the index table. Each of these fixtures holds 2 RH and 2 LH automobile front suspension support arms. Four ROTO-MATIC Power Heads, each having four spindles, perform the following operations:

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4. Finish Ream .8635/.8637"—Full length of hole.
5. Load and Unload.

Two RH and two LH pieces are completed at the end of each cycle. Cycling is automatic, and, operator loads and unloads during machine cycle.

4 New Davis & Thompson Mechanical Power Heads

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Since the first announcement, hundreds of tool steel users have received their CRUCIBLE TOOL STEEL SELECTORS. The comments received indicate that this handy method of *picking the right tool steel right from the start* is going over big.

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FOUR STEPS—and you've got the right answer!

1. Move arrow to major class covering application
2. Select sub-group which best fits application
3. Note major tool characteristics (under arrow) and other characteristics in cut-outs for each grade in sub-group
4. Select tool steel indicated

That's all there is to it!

Here's an example:

Application—Deep drawing die for steel

Major Class—Metal Forming—Cold

Sub-Group—Special Purpose

Tool Characteristics—Wear Resistance

Tool Steel—Airdi 150

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And you're sure you're right!!

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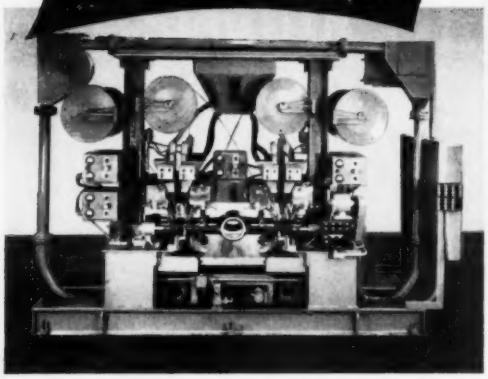

Hapman

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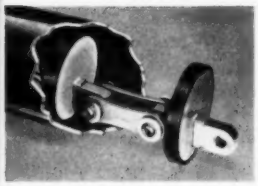

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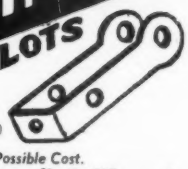

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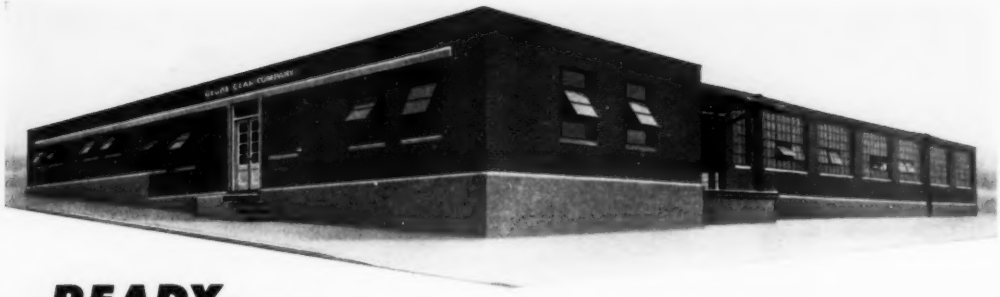

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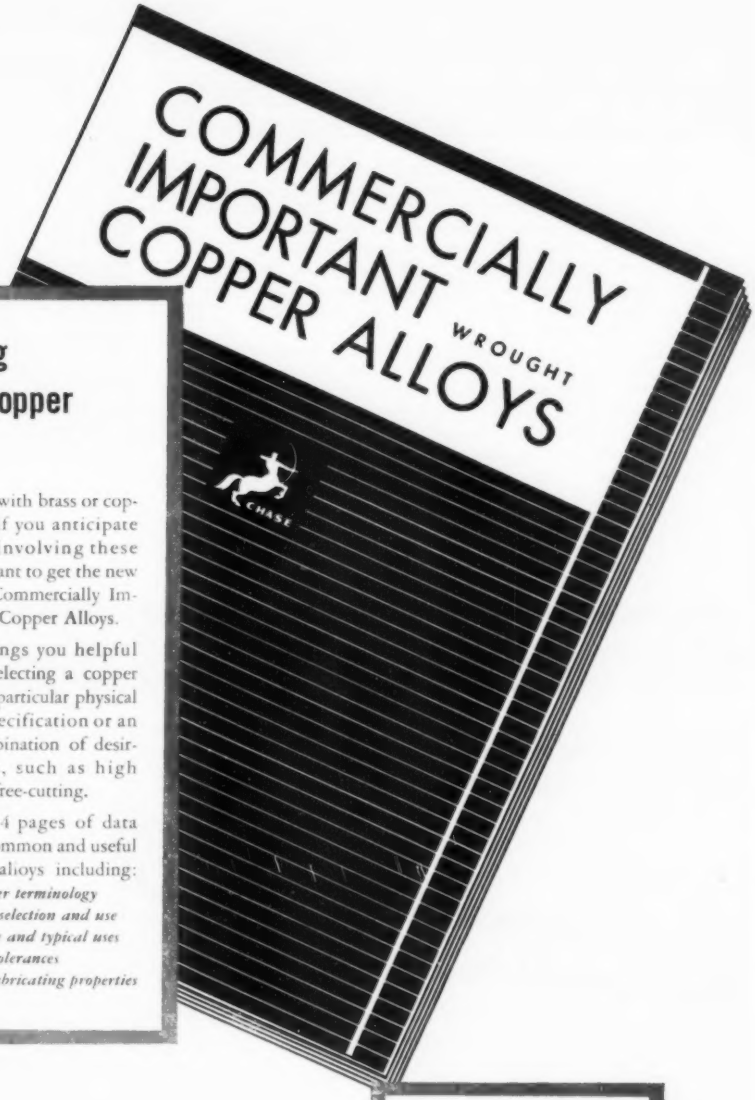

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If you're working with brass or copper alloys . . . or if you anticipate defense orders involving these metals . . . you'll want to get the new Chase book on Commercially Important Wrought Copper Alloys.

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CHASE 75th ANNIVERSARY

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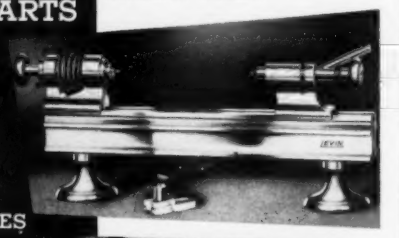

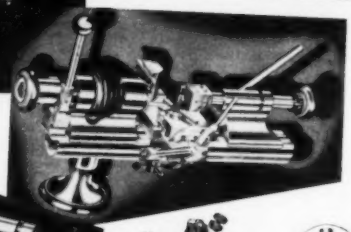

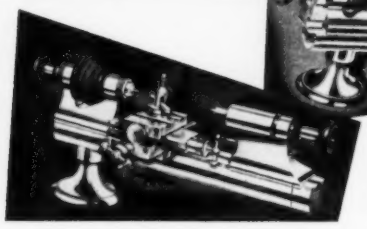

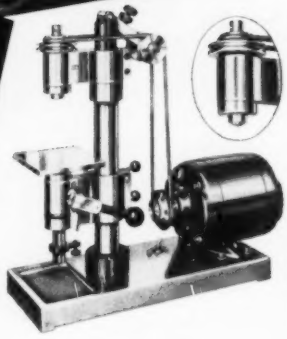

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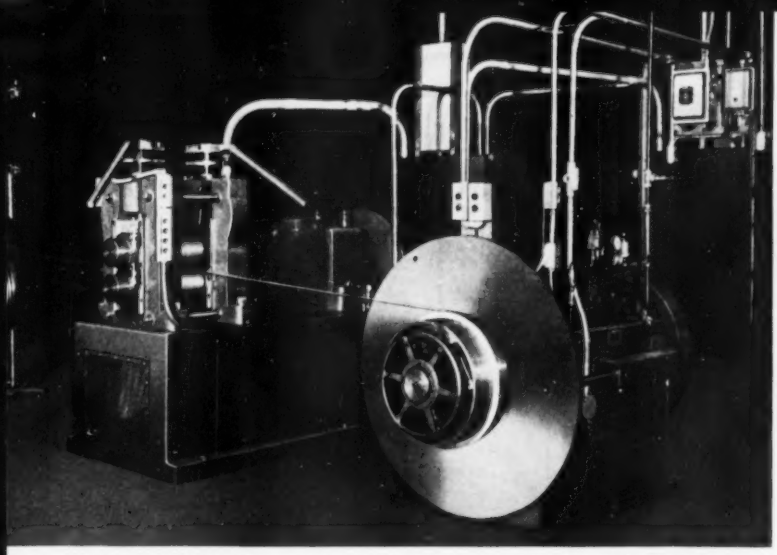
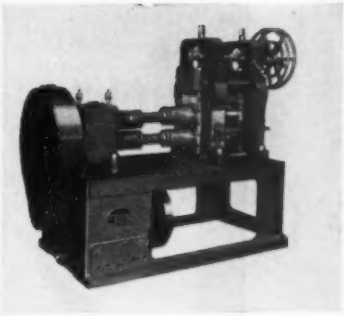


THIS FENN COMBINATION, consisting of the new No. 061 Two-High Roller Bearing Rolling Mill and No. 30 Take-Up Reel, installed at Federal-Mogul's St. Johns, Michigan Plant...



GREATER ACCURACY of the new No. 061 Two-High Rolling Mill comes from heavier roll construction made possible by Fenn-designed extra-heavy precision roller bearings. Roller thrust bearings on outer bearing boxes maintain axial alignment, eliminating marks or "shadows" on the stock. Universal joint and herringbone gears provide smoother drive from motor through to rolls, for smoother finish of strip.

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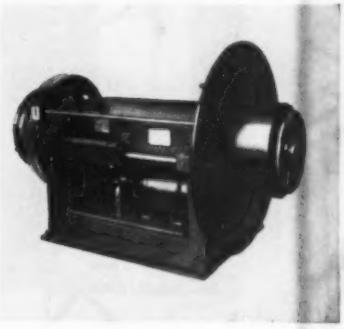
To get these benefits at their fullest, Fenn units are the obvious choice. The installation shown above, for example, is one of many typical Fenn combinations for the production of ferrous or non-ferrous strip—at top speed and lowest cost.

GET THE WHOLE STORY

Fenn Roller Bearing Rolling Mills are available in Two-High and Four-High models, with roll diameters from 4" to 16", single or tandem units, speeds up to 2,000 ft. per min. Fenn Take-Up Reels are made in a range of sizes for either traversing or "pancake" winds. For full information about their many cost-saving, efficiency-boosting advantages, contact your nearest Fenn Distributor, or write direct to

THE FENN MANUFACTURING COMPANY
1859 Broad St., Hartford 1, Connecticut



FASTER REMOVAL of finished coil is one big advantage of Fenn's No. 30 Take-Up Reel — resulting from such design-improvements as collapsing drum and hydraulic stripper. Having a capacity of 3,000 lbs. of coil, while providing a tension of 2,500 lbs., it combines with the Fenn Mills to handle up to 2,000 ft. of strip per min.

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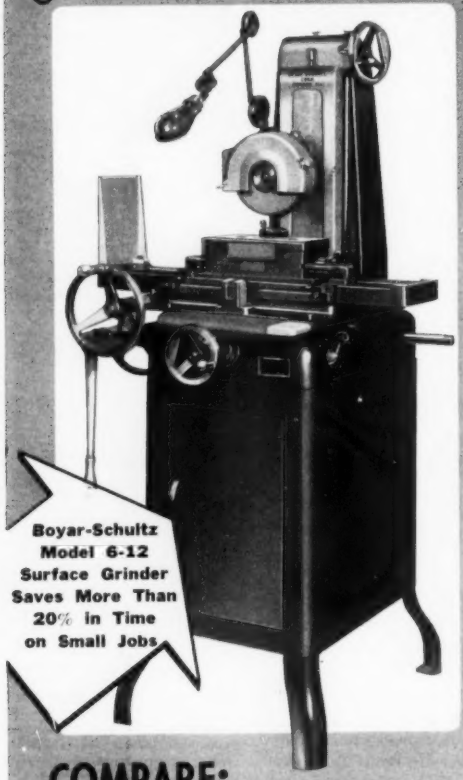

Boyar-Schultz Model 6-12 Surface Grinder Saves More Than 20% in Time on Small Jobs

COMPARE:

PERFORMANCE—Flat, accurate surface finish — precision vertical spindle control — fast, easy longitudinal and cross feed operation — less operator fatigue.

MANUFACTURE—High alloy castings — precision parts — ground thread screws — protection against abrasive wear — accurate, long wearing ways — high precision smooth running spindle — needle bearings on all hand wheels — precision assembly.

APPEARANCE—A small machine with big machine accuracy and performance — fits into any shop — streamlined for easy maintenance — sturdy cabinet.

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Whatever your problem, our design, engineering and production facilities can help you solve it!
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BUILDING COMPLETE MACHINE TOOLS
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COLUMBUS DIE-TOOL and Machine Co.

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HEAT TREATING EQUIPMENT
GAS CARBURIZERS · POT FURNACES · CONTINUOUS FURNACES
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STAMPS UP TO 3/8"
DIE WHEEL HOLDS 40 CHARACTERS.
DIE WHEELS ARE INTERCHANGEABLE.
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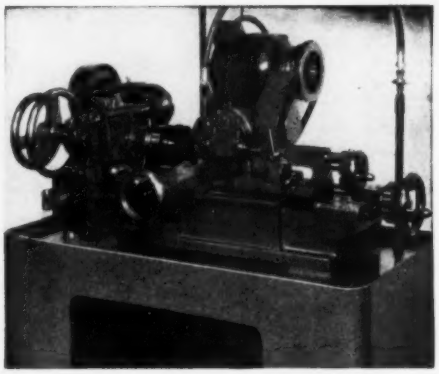

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. . . for producing accurate, fine-finish threads on small diameters at low cost

This NEW model is mounted on a welded steel base in which are accessibly located control panel, coolant motor and pump. It is equipped with separate motors for cutter, work and coolant. Motor push buttons are conveniently placed.

Swing over carriage is 3" and work 2" diameter or smaller can be handled. Threads 8¾" long can be cut with work held on centers. Special attachments are available for extending the utility of this machine. *Illustrated literature available on request.*

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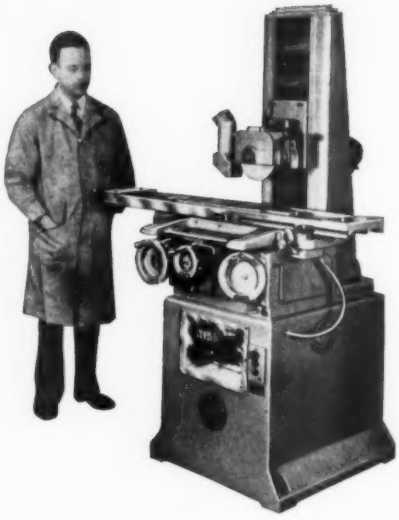
HIGH STREET WALTHAM, MASS.



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WITH VARIABLE TABLE SPEED - 12 to 35 Feet Per Minute

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RIVETERS — PIONEERS in their line—head rivets from smallest to ¾" diameter either by NOISELESS SPINNING or VIBRATING HAMMER method—Sizes to meet all needs—Types include Vertical and Horizontal Multiple Spindles.

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Automatic Dieing Machines combine high speed with long die life in production of metal stampings.

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AMERICAN
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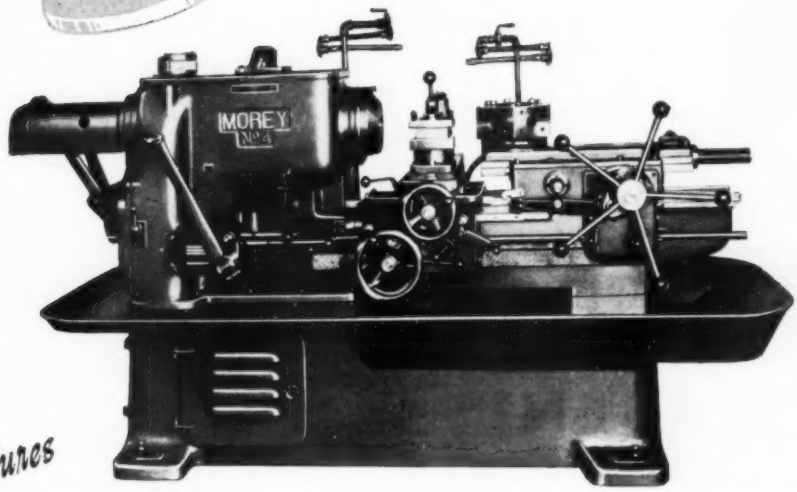
TURRET LATHES

No. 2 Plain Type

Nos. 3, 4 and 5 Universal Type



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Infinite variable vibrationless spindle speeds.

Remote speed selection control for speed and ease of operation.

The newly designed MOREY TURRET LATHES take advantage of tungsten carbide tools and incorporate all technical improvements in metals, electronics and hydraulics . . . our design is not hampered by tradition.

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No. 3 Universal	1½" x 10"	16½"	5 HP
No. 4 Universal	2" x 12"	19½"	7½ HP
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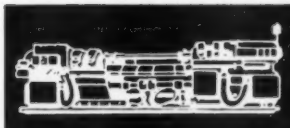
OBTAIN MAXIMUM PRODUCTION WITH MINIMUM EFFORT FROM MOREY TURRET LATHES . . . INVESTIGATE!



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for heavy blanking and forming

Heavier classes of blanking and forming work can be handled efficiently and economically on these presses.

Sturdily constructed with either solid frame or built up with tie rods. Small elastic deflections do not affect tool alignment. All stresses taken centrally. Made also with wedge adjustment for slide for very close work.

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We can do this double job if we all work together to turn out more for every hour we work—if we use our ingenuity to step up productivity.

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. . . and this applies to every "A" cutter ever made!

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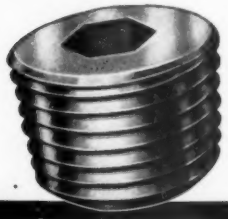
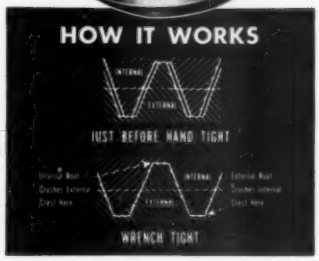
DRYSEAL

THREAD

PRESSURE PLUG





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No. 3A Warner & Swasey Saddle Type Turret Lathe, M.D.
No. 4A Warner & Swasey Saddle Type Turret Lathe, M.D.
No. 3L Gisholt Geared Head Turret Lathe, serial ⁄687.24, bar feed and chucker, late
No. 4R Acme Turret Lathe, bar feed, late
No. 2H Kearney & Trecker Milling Machine, late
No. 2K Kearney & Trecker Milling Machine.
No. 3 Cincinnati Hi-Power Vertical Milling Machine.
36-90 Cincinnati Hydromatic Duplex Milling Machine, serial ⁄3B38D1L-1, late.
No. 3VG Reed Prentice Vertical Mill, late
No. 14 Cochrane-Bly Universal Mill Shaper.
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No. 72A5 Heald Plain Grinder, late
No. 2 LaSalle Hydraulic Surface Grinder, late
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1⅝" RA-4 Acme Gridley Automatic. Late.
9/16" RA-6 Acme Gridley Automatic. 1942.
1-1/16" Cleveland, Model A. 1943.
2" Cleveland, Model A. 1942.

DRILLS
No. B2A Natco Single Spdl. Latest.
16 Spindle Barnes, Hydraulic, 1942.

DRILLS, SENSITIVE
No. 4B-12 Edlund. 1942.
No. 2B-8 Edlund. 1942.

GEAR EQUIPMENT
No. 6 Gleason Revacycle Generator. 1940.
No. 645A3 Fellows Gear Shaper. 1943.
No. 72 Fellows Gear Shaper. 1942.
No. 7 L.S. Fellows Gear Lapper. 1944.
Pratt & Whitney Gear Grinder. 1942.
8" Red Wing Internal Shaver. 1942.
15" Red Wing External Lapper. 1942.
Red Wing Univ. Gear Checker. 1942.

GRINDERS, CYLINDRICAL
14"x168" Norton Plain Type C. 1942.
14"x48" Norton Type C Pl. Hyd. 1941.
14"x46" Landis Type C Pl. Hyd. 1943.
10"x36" Cincinnati Plain Hyd. 1942.
10"x18" Landis Type C Pl. Hyd. 1942.

GRINDERS, INTERNAL
No. 24-36 Bryant Hydraulic. 1943.
No. 16 CP 16 Bryant Hydraulic. 1942.
No. 16-16 Bryant Hydraulic. 1942.
No. 172 Heald Hyd. Cap. 1940.
No. 81 Heald Plain Hyd. 1940.
No. 75A Heald, Two Motor. 1943.
No. 72A3 Heald Plain Hyd. 1943.
No. 50 Heald Plain Hydraulic. 1943.
No. 104 Rivett Int. & Ext. 1943.

GRINDERS, SURFACE
14"x38" P & W Vertical Hyd. 1942.
No. 22 Heald Rotary, 12" Chuck. 1943.

GRINDERS, THREAD
No. 31 Excello Thread Grinder. 1941.

GUN BARREL MACHINES
No. ½Bx50 P & W Reamer. Latest.
No. ½Bx30 P & W Reamer. Latest.
No. ½Bx50 P & W Rifler. Latest.

LATHES, ENGINE
20"x20' Center LeBlond Heavy Duty. 1941.
16"x77" Axelson. Late.

LATHES, PRODUCTION
No. 3FU Foster Fastermatic Platen. 1942.
No. 3D Gisholt Simplimatic. 1939.
20"x25" Fay Automatic. 1942.
14"x42" Monarch "Magna-Matic." 1941.
10"x12" LeBlond Multi-Cut. Late.
Lipe Carbo-Matic. 1942.
Lipe Mechanical Carbo. 1942.

LATHES, TURRET
No. 3AL Gisholt Universal. Late.
No. 5 Gisholt Universal. 1942.
No. 4AR Libby Hand Carriage. 1942.
No. 3 Gisholt Universal. 1942.
No. 2 Warner & Swasey Simplified. 1941.

MILLS, PLAIN
No. 2L Cincinnati. 1941.
No. 4B Kearney & Trecker. M.D.
No. 3B Kearney & Trecker, M.D.

MILLS, PRODUCTION
No. 3A Sundstrand Copy Mill. 1942.
No. 1-8 Kent Owens. Late.

MILLING MACHINES, THREAD
6"x30" Lees-Bradner, Model LT. 1942.

WELDERS
Taylor-Winfield Hi-Wave. 1940.

Write for latest stock list

INDIANAPOLIS *Machinery & Supply Co.*
1961 S. Meridian St. . . Indianapolis, Indiana

MacDell Availables in Late Type Guaranteed Machine Tools

Gisholt 3S Dynetric Balancer Mfg. 1942

Lodge & Shipley 3A Duomatic Lathe Mfg. 1943. 20" swing, 27" centers

Bardons & Oliver ⁄2 Geared Electric Turret Lathe (2 available) Mfg. 1942

Heald No. 25A Rotary Surface Grinder. 24" Chuck Mfg. 1941

Knight ⁄40 Vertical Mill, complete with jig boring equipment. Mfg. 1942

Cincinnati 2-18 Rise & Fall Mill Mfg. 1941

Brown & Sharpe No. 12 Automatic Mill 18" Table Travel Mfg. 1942

Brown & Sharpe No. 2 14"x30" Universal Grinder Complete Internal Attach. Mfg. 1942

Cleveland 3¾" Model A Single Spindle Automatic with Tooling Mfg. 1943

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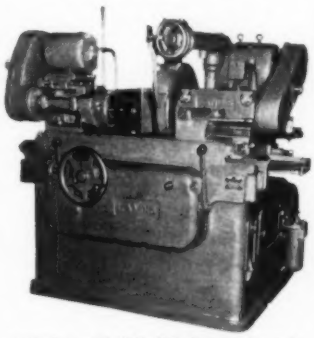
AUTOMATIC, #00 Brown & Sharpe, 5/16" cap.
AUTOMATIC, Cleveland Model #B-1½" Sgl. Spdl.
AUTOMATIC, B & S #2G, 1" Cap. M.D.
AUTOMATIC, #33 Acme-Gridley 4-Spdl. 1" Cap.
AUTOMATIC, National-Acme Sgle. Spdl. 4¼".
BORING MILL, Lucas #31 Horiz. 3" Bar.
BORING MILL, Giddings & L #32 Horiz. 2½" Bar.
BORING MILL, Ryerson #11 H.
BORING MILL, #0 Giddings & Lewis, 3½" Bar.
BORING MILL, 24" Bullard M.D., V.T.L.
BORING MILL, Bullard 36" Rapid-Prod., M.D.
BARRELS, Tumbling, Almco, Lupomatic, Baird.
BORING MILL, Cleveland Horiz. 2½" bar, cap.
BUFFER, Model #95 U. S. Electric, 4 speed.
BROACH #3 LaPointe Horiz. 50" Str.
COMPRESSOR, Chicago Pneumatic 178 CFM.
CRANE, OET Shaw 10 tons, 56'8" span.
CHIP WRINGER, Barrett #251, M.D., 18" dia.
CUTTER, 74" Oswego Automatic Paper, M.D.
CRANE, OET Ricker 2 tons 11'9" span.
RADIAL DRILL, 4'x11" Cinc-Bickford, M.D.
RADIAL DRILL, 6'x18" American, M.D.
RADIAL DRILL, Cinci.-Bickford 3½x9", A.C., M.D.
RADIAL DRILL, Cinci.-Bickford 5' arm, 13" col.
DRILL, #121 Baker Auto. S.S. Cam Operated.
DRILL, Deep Hole, Avey-Draulic #2.
DRILL, Deep Hole, Pratt Whitney #2 Gun Barrel
DRILL, Edlund #2B, 3 spdle, #2 M.T., 18".
DRILL, Cincinnati 21" with Tapping Attach.
DRILL, Natco Multiple Spindle #12, #1 M.T.
DRILL PRESSES, Leland Gifford #1MS, 1, 2, 3, 4
DRILL PRESS, #2MB Buffalo Forge single spindle.
DRILL, Barnes, 24" S.S., #4 M.T., 1¾" cap.
DRILL PRESS, #25 Foote-Burt S.S. 24", #5 M.T.
DRILL, #2MS Leland Gifford, 4 spindle, #2 M.T.
DEEPFREEZE, Cascade 120° F., Industrial Chilling
FILING, #3 Thiel & Sewing, M.D.
FURNACE, Westinghouse Elec. 18 KW, 2100° F. cap
FURNACE, Wasnier Steam Oven, Serial #3343.
GRINDER, Diss, Besley #20S, 18" Dble. end
GRINDER, Arter 18" Rotary surface.
GRINDER, Cylindrical, Brown & Sharpe #2 Univ.
GRINDER, Oakley #3 Univ. Tool & Cutter.
GRINDER, G & L #4 Univ. Tool & Cutter
GRINDER, Heald Rotary #25.
GRINDER, Hydraulic Contour Landis Cam 5"x40"
GRINDER, Cylindrical, Norton 10"x24".
GRINDER, Brown & Sharpe #4 Univ. 12"x60".
GRINDER, Brown & Sharpe Cylindrical #10, 6x18.
GRINDER, Cylindrical, Cinci. 6x18 Filmatic.
GRINDER, Thread, Jones & Lamson #TG-615
GRINDER, Landis Crankshaft 10x32 Hydraulic
GRINDER, Brown & Sharpe #2 Auto. Horiz. Surface
GRINDER, Heald #72A-3 Internal Size-Matic.
GRINDER, Pratt & Whitney 14x36 Vert. Surface.
GRINDER, Pratt & Whitney 22"x84" Vert. Surface.
GRINDER, Springfield #2 Planer Type Surface.
GRINDER, Greenfield #12 Int. Hydromatic
GRINDER, #51 Oliver Auto. M.D. Drillpointer.
GRINDER, #33 Abrasive Vert. Auto. Surface.
GRINDER, #22 Heald Horiz. Rotary Surface
GRINDER, Diamond Snagging 10 HP, 24"x41½"

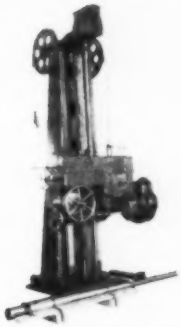


LANDIS 6 x 18 Hyd. Cyl. Grinder, Type C. Serial #29196.

GRINDER, #60 & #70 Heald Internal.
GRINDER, Landis 6"x18" Hyd. Cyl. late type.
GRINDER, Sellers Type #1A Tool, 24" wheel.
GEAR HOBBER, #3 Barber Colman, M.D.
GEAR HOBBER, B & S #34 Spur. 18" dia.
GEAR SHAPER, Fellows #0 High Speed.
GEAR SHAPER, Fellows #72 High Speed.
GEAR SHAPER, Fellows #7 High Speed.
HAMMER, Rochester Hispeed, all sizes M.D.
HAMMER, Bradley 200# Rubber Cushioned Helve.
HEADER, Manville #1 S.S.S.D. Cold, 3/16".
HEAT TREAT ROOM, complete with Furnaces.

BENDING ROLLS
Hilles & Jones #6 Pyramid Type Motor Driven Plate Bending Rolls. Size—14'x¾" Plate. Top roll—22" dia. Lower rolls—15" dia. Imm. Deliv.

KEYSEATER, #5 Mitts & Merrill, Giant, M.D.
LATHE, Bulling Dble. End #VMTS, Devine Bros.
LATHE, Pond 30"x108" Grd. Hd. With Equip.
LATHE, Bridgeford 32"x16' Q.C.G. Grd. Hd.
LATHE, Lodge & Shipley 24"x8' Heavy Duty.
LATHE, LeBlond 24"x14' Q.C.G. Grd. Hd.
LATHE, Hendey 20"x10' Q.C.G., Taper Att.
LATHE, Reed-Prentice 20"x10' Grd. Hd.
LATHE, Lodge & Shipley 18"x8', Q.C.G., Gr. Hd.
LATHE, American 18"x10' Q.C.G., Grd. Hd.
LATHE, American 18"x8' Q.C.G. Grd. Hd.
LATHE, LeBlond 18"x8' Q.C.G. Taper Attach.
LATHE, Lodge & Shipley 16"x8', Q.C.G., Grd. Hd.
LATHE, Hendey 14"x8' Q.C.G. Taper Attach.
LATHE, LeBlond 14"x8' Q.C.G.
LATHE, Hendey 12"x8' C.C.G. Taper Attach.
LATHE, Le-Swing 9"x108", M.D., A.C.
LATHES, TURRET, Warner & Swasey Univ. #4 1½".
LATHE, TURRET, Warner & Swasey #3A Univ. Grd. Hd. Bar feed, tooling & collets, AC Motor.
LATHE, TURRET, Simmons #2 Vari Drive 220 V.
LATHE, Porter-Cable 9"x15" Geared Head Prod.
LATHE, Turret Oster #601 W.O. Rapiduction.
LATHE, TURRET, Warner & Swasey #6 Grd. Hd. Ram Type, Bar Feed, Motor in base.
MILL, 2A Brown & Sharpe Horiz. Univ.
MILL, #4B Brown & Sharpe H.D., Horiz.
MILL, #14 Garvin Plain Horiz.
MILL, #0Y Brown & Sharpe Plain Horiz.
MILL, Bridgeport Model #BH, M.D.
MILL, Van Norman M.D. Hand Mill, late.
MOTOR GENERATOR SET, 100 KW Gen. Elec.
MILL, Cinc. Horiz. #2, #3, #4, #5, High Power.
MILL, Cinc. Vert. #2 #3, #4, High Power.
MILL, Cinc. 16" Mfg. Type with Vert. head. Late.
MULT-MILLER, U.S. Tool #MM-1-S, Auto. Prod.
MILL, #30H Sundstrand Two Spindle Hyd.
MILL, PLANER, Ingersoll 42x30x12, 4 heads.
MILLING MACHINE, Kempsmith #3, Horiz. Univ.
MILLING MACHINE, LeBlond #4 Horiz. Univ.
MILLING, Brown & Sharpe #1½ Horiz. Univ.
MILLING, MACHINE, Kempsmith #2 Horiz. Univ.
MILLING, Brown & Sharpe #2 Horiz. Univ.
MILLING MACHINE, Van Norman #2 Duplex.
MILLING MACHINE, K & T #2B, Horiz.
NIBBLER, #2 Savage Roller Die ⅝"x36" cap.
NIBBLER, Gray Turret Type ¼"x24" cap.
OZALID Model "F" Whiteprint Machine
THREADING, Staybolt Lassiter Millholland 1½".
THREAD MILLER, Hanson Whitney 4"x9" Univ.
THREAD MILLER, Less Bradner #40A Automatic



#11 Ryerson Horizontal Drilling and Boring Machine, 5½" diam. spindle.

THREAD MILLER, Plan-O-Mill #3 Planetary Form & Thread Semi-Automatic Milling Machine.
PAPER SHREDDER, #10 Mitts & Merrill, M.D.
PLANER, Gray 30"x30"x10' A.C. Motor Dr.
POWER PRESS, Bliss #184 Open Back.
POWER PRESS, Bliss #3A S.S. Dble. Crank Grd. 45 tons, 4" stroke, 30"x24" Bed Area.
POWER PRESS — Bliss - Consolidated #163 - B Straight Side Dble. Crank, 45 tons.
PRESS, #78½ Bliss S.S. 9½" Str. M.D.
PRESS, Robinson #5 O.B.I. 85 tons. M.D.
PRESS, Federal #2 O.B.I. Grd. 2" Stro.
PRESS, Bliss #18, #19, #29, #21, OBI, A.C., M.D.
PRESS Toledo 59½ S.S. 440 ton cap. 9" str.
PRESS Waterbury-Farrell High Speed 90 tons #3W.
PRESS, #8C Bliss Double Action, 3 crank.
WHEEL PRESS, Caldwell 200 tons cap. Hyd.
PRESS, Lucas 15 tons Power Arbor M.D.
PRESS, #60 Whitney Deep Thr. 24", foot.
PRESS, P2, P3 Ferracute M.D. Roll feed

LESTER PHOENIX DIE CAST MACHINE
Model HP-2-SF. For alum., brass, and magnesium. Late model, 1947. Used less than 100 hrs., Imm. Deliv.

PANTOGRAPH, #1A Gertes M.D. Engraving.
PUNCH, Hecker Turret, 8 station, cap. 2½" hole.
PUNCH, H & J #2 Sgle. End. 24" Thr. 1" thru 1".
PUNCH, H&J #5 Sgle end. 48" Thr. 2" thru 1½".
RIVET SETTER, ⅝" cap. Posn. Tubular Rivet.
ROLLS, #1 Buffalo Forge Wrapping.
ROUTER, #W240D, Onsrud, Electric H.D.
COLD SAW, Espen-Lucas #700, 48" dia. blade
CUT-OFF SAW, Yates-American #M-99.
SAW, #302 Campbell Abrasive Cut-off.
SAW, #28-C Rosins Shear Cut 6"x9" cap.
SAW, NSIB-10 Grob Band & Butt Welder.
SAW, Band, Tannewitz #GH-36" High Speed
SHAPER, 16" American B.G. Motor drive.
SHAPER, 32" Cinc. B.G., Motor driven.
SHAPER, Columbia 32" B.G. Crank.
SHAPER, Morton 30" Draw-Cut, 4-Speed.
SHAPER, G & E 24", high duty, back geared, M.D.
SHEAR, Quickwork #A-1 Rotary 60" Throat. 18 ga.
SPRUE CUTTER, Milwaukee 56 tons, 2½" cap.
SURFACE PLATES & TABLES, all sizes.
WELDER, 200 KVA Federal, Projection.
WELDER, 75 KVA Federal, M.D., Spot.
WIRE STITCHER, Morrison and Acme. M.D.

OVER 2000 MACHINE TOOLS AVAILABLE "IN STOCK"

Eastern Rebuilt Machine Tools

THE SIGN OF QUALITY—THE MARK OF DEPENDABILITY

ARBOR PRESSES

No. 37E Wilson Hydraulic, hand operated, cap. 50 tons, new
No. 37F Wilson Hydraulic hand operated, cap. 75 tons, new
No. 3 Famco Bench Type, 3 tons pressure
King Screw Press, o.p.d.

AUTOMATICS

4 SPINDLE 1½" Conomatic, m.d., bar, 1942 machine
No. 6A Potter & Johnston, m.d.
No. 6C Potter & Johnston, m.d.
14" Fay Flanders Type, m.d.
4 spindle 2¼" Cleveland Model "K", m.d.
2¼" Gridley Single Spindle, m.d.
2½" Cleveland Model A, m.d.
4¼" Cleveland Model A, m.d.
6" Cleveland Model A, m.d.
7⅝" Cleveland Model A, m.d.

BOLT THREADERS

¾" Style R Economy Automatic Threading Machine, belt
Victor Nut Facing Machine, m.d., cap. ⅜" to 2" nuts
1" Landis Double Spindle, m.d. thru gear box
1½" Landis 2 spindle, latest
1½" Landis 2 spindle, older type

HORIZONTAL BORING MILLS

3½" bar Landis Floor Type, m.d.
4" bar Detrick & Harvey Floor Type, m.d.
5" bar Barrett, m.d.
5½" bar Niles, m.d.
10" bar Sellers Floor Type, m.d.
Pair tables for use on Floor Type Horiz. Boring Mill, 8'9" long x 17½" wide x 38" high, 2 T slots
Floor Plate 76" wide, 21'8" long overall, 9" thick, 5 T slots
Pair tables for use on Floor Type Horiz. Boring Mill, 8' long x 15¾" wide x 33" high, 2 T slots

VERTICAL BORING MILL

42" Bullard Spiral Drive, m.d.
24" Bullard New Era, m.d., with side head
42" King, belted m.d., 2 swivel heads, p.r.t.
44" Niles, m.d., 2 swivel heads, p.r.t.
53" Niles, 2 heads on rail
100" Niles Heavy, m.d., p.r.t.

BROACHING MACHINES

75 H.P. LaPointe Hydraulic Broach, m.d.
Cincinnati Mill Broach, m.d., 10" spindles, new

BALL BEARING DRILLS

Canedy Otto Bench Type, 8" overhang
Allen Bench Type, m.d., ½ H.P. motor, 12" overhang
Automatic Sensitive, m.d., ½" cap.
Mason Bench Type Single Spindle, belt
Providence Engineering Co., Model E, o.p.d.
No. ½, 1, 2 Avey, belted m.d.
No. 1B Edlund, m.d., new
No. 2—12" Foote Burt Single Spindle, m.d.
No. 4 Fosdick, 8" overhang, belted m.d., No. 2 Taper
No. 5M—16" Fosdick, m.d.
1 spindle Allen, belt drive
2 spindle Allen, belted m.d., 8" overhang
2 spindle Avey, size No. 1, Type B, style VHP, m.d., 8" overhang
2 spindle No. 3 Avey, belted m.d., p.f.
4 spindle No. 3 Avey, belted m.d., No. 3 Taper, 12" overhang
6 spindle Leland & Gifford No. 2 Taper, m.d. on each spindle
6 spindle No. 2B Edlund, m.d., No. 2 Taper
6 spindle No. 3 Avey, belted m.d., No. 3 Taper
6 spindle Henry & Wright, m.d., 15" overhang, No. 2 Taper
#FLMS—3 spindle Leland & Gifford High Speed, m.d., late

HORIZONTAL DRILLS

3 way Natco Horiz. Drill, consisting of 3-E13 Hole-units

No. 1⅛Bx30" Pratt & Whitney 2 spindle Deep Hole Reaming Machine, m.d.
No. 1⅛Bx30" Pratt & Whitney Gun Barrel Rifling Machine, m.d., latest
No. 1Bx74" Pratt & Whitney 2 spindle Deep Hole Reaming Machine, m.d., latest
No. 1⅛x105" Pratt & Whitney 2 spindle Deep Hole Drill, m.d., latest
No. 1½x105" Pratt & Whitney 2 spindle Gun Barrel Rifling Machine, m.d.
No. 1 Pratt & Whitney 2 spindle Deep Hole Drill, belted m.d.
No. 1½ Pratt & Whitney 2 spindle, m.d., older type
Pratt & Whitney Rifling Machine, belt
3 spindle Detroit Semi-Automatic, belt
2 spindle No. 410 W.F. & John Barnes Deep Hole Drill, m.d.
Special Horiz. Drilling Machine, Cincinnati-Bickford Head mounted horizontally on base

MULTIPLE SPINDLE DRILLS

No. 3 Baush, m.d., 16x30" Head, 15 spindles
No. 3 Baush, m.d., 20x40" Head, 15 spindles
No. 16 Foote-Burt Fixed Center, m.d.
3 spindle 12" Rockford Gang, m.d.
4 spindle Foote-Burt Rail, No. 4 Taper, m.d.
6 spindle Niles-Bement-Pond, m.d., 12' rail, No. 5 Taper

RADIAL DRILLS

3' American Sensitive, cone
4' American Triple Geared Plain, 13" col., m.d. thru gear box on base
4' Niles-Bement-Pond Semi-Universal, m.d.
5'-16" col. American Triple Purpose, m.d.
6'-15" col. Cincinnati-Bickford, m.d.
7'-12" col. Dreses, gear box, m.d.
4'-12" col. Fosdick, m.d. on base

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MElrose 1241
CABLE ADDRESS EMCO

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BEMENT MILES 18" SLOTTER with 3" dia. spindle. M.D.

GOULD & EBERHARD 36" Gear Cutter M.D.

BROWN & SHARPE #5—48" Gear Cutter, M.D.

BINSEE MACHINERY COMPANY HORIZONTAL BORING MILL. Table 30"x64". Quantity of boring bars.

CINCINNATI 60"x48"x14' Planer. 4 heads. 1 extra side head on massive floor stand for open side work. M.D.

B & O #2 Turret Lathe 1" Cap. M.D.

AMERICAN 20"x16' QUICK CHANGE GEAR LATHE. M.D. Old, but good.

BARNES HEAVY DUTY 26", 4-SPINDLE DRILL. 1 spindle for tapping M.D. #4 M.T.

GRINDERS—CYLINDRICAL. B & S #11. 7"x 32". Plain Grinder. Table swivels. Motorized with 4 motors.

LANDIS 10"x36" Plain, M.D. Also Planer type Grinder 16"x36".

"BEMENT" 26" STROKE TRAVERSING HEAD SHAPER. 48" travel to ram. 2 tables. (PLANER SHAPER)

WE HAVE A LARGE STOCK FROM WHICH TO SELECT. TELL US WHAT YOU WANT.

THE OSBORNE & SEXTON MACHINERY CO.

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BOLT THREADER, 1½" Williams Reliance
BORING MILL, 3½" bar G. & L. Table Type M.D.
BORING MILL, 100" Cinci, Massive, 2 Hds., M.D.
BORING MILL, 72" Gisholt, 2 hds., P.R.T.
BORING MILL, 72" N.B.P., P.R.T., M.D.
BORING MILLS, 4" bar Landis Floor 4½" bar Niles table, Dual Control, 3" bar Univ. 3½"
BORING MILLS, 3½" bar G. & L. Table Type M.D. 6½" bar Niles, Floor Type
BORE-HONE, Barnes, 10" stroke, 6" bore, '42
BRASS LATHE, 21" Acme, Late, Hardened Ways
DRILLS 21" Royersford-Excelsior New & Used
DRILL, 25" Weigel, Tapping, M.D.
DRILL, 6 Spin. Allen, Pw. Fd., No. 2 M.T.
FACE GRINDER, 84" Bridgeport 32" wheel
GEAR GENERATOR, 3" Gleason straight, Late
GEAR HOBBER, 36H Gould & Eberhardt
GEAR HOBBER, #12 Barber Colman
GEAR PLANER, "1" Rienecker, Bevel
GEAR SHAPER, No. 75 Fellows High Speed 6IA, 6I, & 6AA, 6 Fellows
GRINDERS, 20"x120" Landis, Cyl., Hyd., AC
GRINDER, 16"x48 Cinci., Cyl., M.D.
GRINDER, No. 6-T Sellers, Tool, '42
GRINDER, No. 16Y2B Bryant, Int., 1943
GRINDER, No. 174 Heald Gap, Int. 54" sw., '42
GRINDER, No. 72A5 Heald Internal, 1943
GRINDER, Micro-Internal, Large
GRINDER, SURFACE, 14"x36" P. & W.
GRINDER, U, UNIV. 12"x36" Thompson M.D.
LATHES, 42"x30' cen. Putnam Grd. Hd. M.D.
36"x20' cen. Putnam, 2 Carr. T.A.
32"x25' cen. Pitts. Bommerfeld, 2 carr. T.A., '42
30"x10' cen. LeBlond Cone
25"x12' cen. LeBlond Grd. Hd., M.D.
25"x12' bed Bridgeford Grd. Hd. (3)
24"x16' bed American T.A. Grd. Hd.
22"/46"x10' cen. Putnam Ext. Bed Gap M.D.
20"x48" cen. Ameri. 8 sp. T.A. (3)
18"x10' bed L. & S. Select. Hd., T.A., M.D.
18"x16' & 12"x6' Handeyc Grd. Hd., T.A. (2)
12"x6' bed Reed Prentice, 14½" sw. Grd. Hd.
TURRET LA., No. 3AL Gisholt, 6¼" hole in spin. 26" Libby "C" 41¼" capty.
No. 1B Foster Univ., 2" capty. (2)
No. 2B Foster Univ. 3½" capty. Bar. Timken #5 Gisholt, Air Chuck, '43
THREAD MILLER, 12"x60" Morey Shields, '42
MILLER, #2H K. & T. Univ. 1944
MILLER, No. 3 Cinci. Pl. Turner M.D.
MILLER, 54" Newton Vert. Rotary M.D. 30 HP
MILLER UNIV., No. 2A Brown & Sharpe
MILLERS, HORIZ. No. 4 Cinci. High Power
PIPE THREADER, 2" Landis, AC. M.D.
PLANER, 48"x36"x8' Cinci. 4 Hd., Box, PRT. Force Feed
RADIAL DRILL, 7'18" col. Amer. Trip. Purp. M.D.
SHAPERS, 32", 20" & 16" G. & E. Gear Box M.D.
SHAPER, 24" Amer. Gear Box M.D.
SHAPER, 28" Columbia, gear box M.D.

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TURRET LATHES

(2) Warner & Swasey Model #2M50 Capacity 1" Round Collet Hand Screw Machines, Chuckers. Serials #556, 154 and 556, 165 (1942)

(4) Warner & Swasey Models #2M70 Capacity 1" Round Collet Hand Screw Machines, Bar Feed Serials #555, 500, and 556, 200 (1942)

(3) Moreys Model #2G—Timken Capacity 1" Round Collet Power Feed to Turret, Bar Feed (1941-2)

(1) Libby (Gisholt) Model #3R—Ram Type Capacity 2" Round Collet Power to Turret, Bar Feed Serial #1044 (1942)

(1) Libby (Gisholt) Model #3R—Ram Type Hole in Spindle 2-3 16" Power to Turret, Chucker, 20" Swing Serial #1102 (1942)

OLDER MACHINES

(1) Libby 5", Bar Feed, Heavy Duty (1930)

(1) Foster #5, Bar Feed, 1-13 16" Collet Cap. (1930)

(1) W & S #4, Bar Feed, 1½" Cap., cone head

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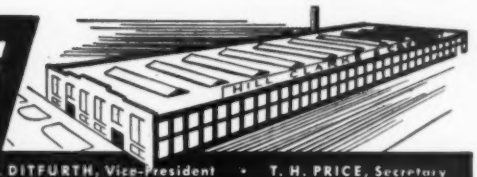
HILL-CLARKE MACHINERY COMPANY



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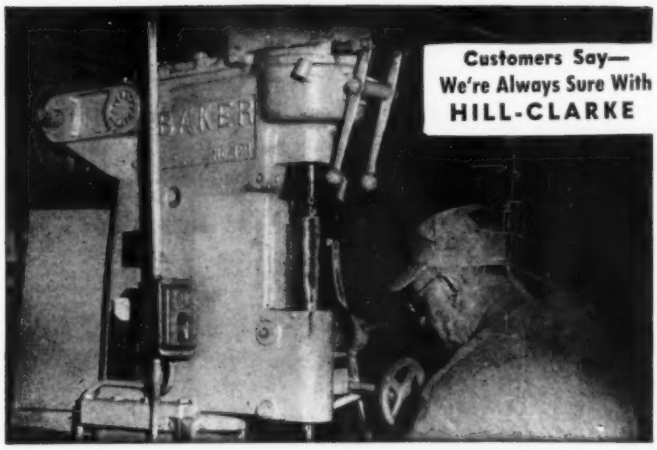


FOR THE 40 YEARS THE OLIVER CORPORATION has purchased Hill-Clarke's machines, they've found thier dependability and long-performance prove their economy over ordinary second-hand machines. Above is one of Oliver's Hill-Clarkes used at their Charles City plant.

AUTOMATICS

¾" G Model Gridley
1-1/16" Model A Cleveland (1942)
1½" Foote Burt (1941)
1¾" Model G 4 Spdl. Gridley

DRILLS

2 Spdl—24" Sw—No. 2 Aveymatic
6 Spdl—14" Sw—No. 2 LMS L.G. Hyd.
D-31 Fox Multiple Drill

GEAR MACHINES

No. 12 HS Gould & Eberhardt Hobber
No. 12-H Gould & Eberhardt Hobber
11" Gleason Bevel Gear Generator
No. 1 Whiton Auto. Gear Cutter
No. 6 Gleason Bevel Gear Tester ('42)
No. 36-BM G & E 3 Spdl. Rougher
No. 65 Fellows—Cone Dr.

BORING MACHINES

3" Lucas Hor. Bor. Mill.
Rockford—3⅛" Bar
42" N-B-P Vert. Bor. Mill.
72" Niles—Hvy. Pattern
No. 624 Fellows Gear Shaper

GRINDERS

4"x18" Landis, Model 4H
6"x18" Norton Type C Plain (1943)
6"x30" Norton Type C Plain (1943)
10"x72" Landis Type C Hydraulic
Hill-Clarke Norton Type Motor Driven Grinders
10"x36" centers
10"x50" centers
10"x72" centers
10"x96" centers
14"x36" centers
14"x72" centers
16"x120" centers
16"-40" gap x 120" centers
18"x96" centers
18"-30" Gap x 96" centers
20"x96" centers
24"-32" Gap x 144" centers
No. A-3—12" Arter Rotary Surf
No. 25-A Heald Surface Grinder
5B Bryant Internal
No. 72-A-5 Heald Internal (1942)
No. 16-16 Bryant Internal Grd.
No. 16-28 Bryant Internal Grd.
No. 24-26 Bryant Internal Grd.
No. 81 Heald Centerless Internal
No. 74 Heald Internal Centerless

LATHES

14"x6' Walcott Lathe
19"x8' LeBlond Hvy. Duty Lathe
20"x9' Chard Lathe
36"x18' Putnam Grd. Hd., M.D.
No. 4 Warner & Swasey Tur.-Bar Fd.
No. 5 B & O Tur. Lathe, Cone Hd.
No. 6 Warner & Swasey Tur.-Bar Fd.
2¼"x24" Jones & Lamson
No. 2A Warner & Swasey s.p.d.
20"x8' Fay and Scott
18" Libby Tur. Lathe, M.D.
21" Gisholt, M.D.

MILLING MACHINES

No. 08 Cincinnati Vert.
No. 3 Sundstrand Rigidmil
6"x36" Lees-Bradner—LT (1943)
6"x80" Pratt & Whitney Thrd. Mill
6"x132" Pratt & Whitney Thrd. Mill
6"x168" Pratt & Whitney Thrd. Mill
10"x48" Hanson-Whitney (1942)

MISCELLANEOUS

24" Milwaukee Shaper
15" Dill Slotter
18" Dill Slotter
38" Morton Draw-Cut Shaper (1945)
18" Newton Slotter
No. 0 Bakewell Tapper
Baush Radial Tapper
No. 307 Barnes Hone
No. 200 Micromatic Horiz. Hone, 1 Spdl.
No. H-2 Micromatic Horiz. Hone, 2 Spdl.
Model 200—H5 Micro.—Horiz.—2 Spdl.
14' Niles-Bement-Pond Roll
Am. Chip Wringers (New) 3.3 to 12.6 bushel capacity
No. 6 R & K Straight-side Press, M.D.
42"-16 Ga. Economy Shear, M.D.
4-B Marvel Hack Saw
No. 5 Reynolds Power Screw Driver
75 Ton Hannifin Hyd. 4 post press

PLANERS

36"x36"x12' Cincinnati, 2 hds.
36"x36"x12' Gray, 2 Hds.
42"x42"x10' Cincinnati 2 hds.
48"x36"x14' Gray, 2 hds.
48"x48"x12' Cincinnati; 2 hds.
48"x48"x12' Gray Maxi-Service
48"x60"x27' American, 4 hds.

FULL MONEY-BACK GUARANTEE

1. Hill-Clarke gives you an unconditional money-back guarantee.
2. All machines in stock.
3. You can see your machine run and tested under power in our plant before purchasing.
4. Complete and modern facilities plus experienced craftsmen for RE-MANUFACTURING machine tools in our 58,000 sq. ft. plant.
5. A responsible organization—with eighty-four years experience.

Write, Wire or Phone **HILL-CLARKE MACHINERY COMPANY**
651 WASHINGTON BOULEVARD, CHICAGO 6, ILL. PHONE Central 6-0500

HEADLINERS

GRINDERS

14" PRATT & WHITNEY Model B Vert. Spindle Surf.
20"x144" Landis Plain Cylindrical, self-cont.
No. 49-53 Besly Vert. Spdle Disc, m.d.
No. 510 Oliver Drill Grinder, late

MILLERS

No. 00 Sundstrand Hydraulic "Rigidmil", m.d., late
No. 1-V Kent-Owens Hydraulic, m.d., late
48" Cincinnati Plain Automatic, m.d.
No. 2 Cincinnati High Power Plain, m.d.
No. 2-B Hvy Brown & Sharpe Plain, arr. m.d.
No. 2-B Milwaukee DOA Universal, spd
No. 4-B Hvy Brown & Sharpe Plain, arr m.d.
No. 2-M Cincinnati Universal, m.d.
No. 3-A Brown & Sharpe Universal, m.d.
32"x24"x16' Ingersoll Adj. Rail, arr. m.d.

LATHES

30"x132" centers American Hvy Pat 12-speed Grd. Hd., m.d., taper
25"x150" ctrs LeBlond Heavy Duty 16-speed Grd. Hd., m.d.
24"x60" ctrs American Heavy Pattern 12-speed Grd. Hd., m.d., taper
24"x51" ctrs Lodge & Shipley 12-speed Selec. Grd. Hd., m.d., taper
21"x136" ctrs LeBlond Heavy Duty, Turner Drive, taper
20"x96" ctrs Lodge & Shipley 12-speed Selec. Grd. Hd., m.d., taper
20"x94" ctrs American Grd. Hd., m.d.
20"x70" ctrs Lodge & Shipley 12-speed Selec. Grd. Hd., m.d.
16"x30" ctrs Lodge & Shipley 12-speed Selec. Grd. Hd., m.d.
14"x30" ctrs Lodge & Shipley 12-speed Selec. Grd. Hd., m.d.
11"x4' LeBlond "Rapid Production" High Speed Grd. Hd., m.d.

No. 608-PV Rivett Precision Toolmaker's, cab. base, quickchange, taper, turret attach., milling attach., 1942.
W. C. Lipe "Planers Carbo-Lathe", m.d., late
30"x30"x8' Gray, 1 head
36"x36"x16' Cincinnati, 2 heads
36"x36"x18' Gray, 2 heads
42"x42"x14' Niles-Bement-Pond, 4 heads
42"x42"x16' Gray, 2 heads
48"x48"x12' Niles-Bement-Pond, 4 heads

MISCELLANEOUS

No. 27 Gleason Hypoid Bevel Gear Testr, late
18" Gleason Str. Tooth Bevel Gear Generator
No. 7 Fellows High Speed Gear Shaper
No. 4 Warner & Swasey Univ. Turret Lathe, m.d., bar feed
Class "F" Bertsch Punch & Shear, 1¼" thru 1", 48" gap
36" Bullard "Rapid Production" VTL, m.d., threading, very clean

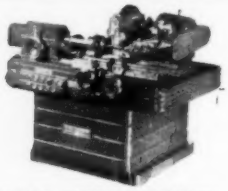
Many other machines in stock. Send for stock list.

COX MACHINERY COMPANY, INC.

3 MINUTES FROM THE CINCINNATI HOTEL DISTRICT

P. O. BOX 1953 CINCINNATI 1; OHIO
Office&Warehouse 311-313 Bakewell St.,Covington,Ky.

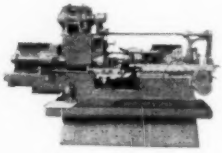
IMMEDIATE DELIVERY



EXCELLO THREAD GRINDERS

Model 231 Excello Precision Thread Grinders. 5" diameter work ground, 18" between centers, 8" maximum thread length ground.

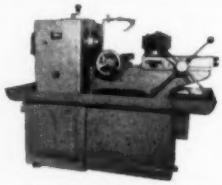
IMMEDIATE DELIVERY



18" CLEVELAND SHAFT MACHINES

Model "B" 18" Cleveland Shaft Machines. 1⅛" Capacity, 19½" stock feed stroke. 13½" Milling length.

IMMEDIATE DELIVERY



OSTER TURRET LATHES

Model 2601 Oster Turret Lathes. 1½" round stock capacity, swing 14", over cross slide 6½.

● These and hundreds of other fine Production Machines now in stock ready for immediate delivery — Automatics — Drills — Broaches — Grinders—Lathes—Mills—Planers—etc.

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GUARANTEED MACHINE TOOLS

LATEST TYPES—1941-1951 MODELS

CAM MILLERS

VAN NORMAN: 10CT Contour Miller, horizontal opposed spindle type for milling flat cams, also can be converted to similar work
FELLOWS: Flat Top Helical Gear Cutter
OLIVER: #2 Face Mill Grinder
OLIVER: 10" Template Tool Bit Grinder
RANSOM: 2-Wheel Grinder 3 HP
RUSSELL: 40" Saw Sharpener (New), automatic indexing from tooth to tooth

DRILLING MACHINES

ALLEN: #2 High Speed, 15" overhang
PROVIDENCE ENG: FV-6 Sensitive 6 motor-driven spindles, ⅜" capacity, high speed type
PRATT & WHITNEY: ½B x 50 Deep Hole Reaming Machine

GEAR CUTTING MACHINES

BROWN & SHARPE: No. 6 Gear Cutter, 72" diameter, 1¾ D. P. capacity
FELLOWS: 61A Shaper, 18" dia.
FELLOWS: 64A Shaper, 18" dia.
FELLOWS: 72 Shaper, 7" dia.
FELLOWS: Straight Line Generator, 3" dia. with many cutters
GLEASON: #12 Rough & Finish Generator
GLEASON: 3" Straight Bevel Gear
SYKES: Gear Shaper 14" external, 20" internal (New)
SYKES: Rack Cutting Machine 24" long (New)

GEAR AND SPLINE GRINDERS

PRATT & WHITNEY: 10" single and double wheel, hydraulic feed
GEAR GRIND MACH: GG-19, 10"x24" Hydr. Spur Gears and Splines
GLEASON: No. 17 Spiral, Zerol & Hypoid, capacity 23½ P.D.

GEAR FINISHERS & TESTERS

FELLOWS: 8LSI and 18LSI Gear Lappers. External & Internal Spur and Helical
FELLOWS: No. 12-C Spacing Tester
GLEASON: No. 4 and No. 6 Bevel Gear Testers, Hand and Power Operated
GLEASON: 3" Bevel Gear Tester
NATIONAL BROACH: SIC—12" Red Ring Tester

GRINDERS—CYLINDRICAL

BROWN & SHARPE No. 23, capacity 10"x48", plain
BROWN & SHARPE: No. 10 capacity 6"x18" plain
CINCINNATI, 6"x18" Hydraulic, plain
CINCINNATI, 10"x36" Hydraulic, plain
LANDIS: 18"x32" Type "D" Crankpin, Hydraulic, for grinding crankshafts
NORTON: 6"x18" plain, hydraulic
NORTON: 10"x18" plain, hydraulic
NORTON: 10"x18" 45° angle wheel head
NORTON: Crankshaft Grinder, 23"x72"

Grinders—Cylindrical—*Cont.*

VAN NORMAN: #666 Crankshaft Regrinder, 20"x48"

GRINDERS—GEAR & SPLINE

GEAR GRIND MACH.: GG-19, 10"x 24" Hydr. Spur Gears and Splines.
GLEASON No. 17 Spiral, Zerol & Hypoid, capacity 23½ P.D.
PRATT & WHITNEY: 10" single and double wheel, hydraulic feed

GRINDERS—INTERNAL

BRYANT: No. 112 with high frequency wheel head, 42000 rpm
BRYANT: No. 5Y Internal
BRYANT: 112 Universal, Hydraulic
BRYANT: 16C16 Hole, Hydraulic
HEALD: 70A Plain, Internal
HEALD: 72A5 Plain & Univ.
HEALD: 72A3 Sizematic Centerless
LANDIS: Hydraulic, 8" stroke x 15" dia.

GRINDERS—RADIUS

VAN NORMAN: #73, capacity 7½" diameter
VAN NORMAN: #639, capacity 7" diameter
VAN NORMAN: #649, capacity 6" to 16" diameter
VAN NORMAN: #3½ Universal, capacity up to 3½" dia.

GRINDERS—SURFACE

ARTER: A-1—8" Rotary
HEALD: 8" Rotary
HEALD: No. 22 Rotary—12" Chuck

GRINDERS—THREAD

EXCELLO: No. 61 external, dia. 5"x 18" centers
JONES & LAMSON: TG-1245 External, 12" dia. x 45" centers, with additional capacity if required

HONING MACHINES

BARNES: No. 306H Vertical, 24" Stroke
MICROMATIC: H-510 Double End Horizontal, ¾" to 2" diameter capacity
MICROMATIC: H-2 Single End Horizontal, 2-spindle, ¼" to 1" dia. capacity

LAPPING MACHINES

FELLOWS: 8LSI and 13LSI Gear Lappers
NORTON: No. 26 Hyprolaps, for flat work & cylindrical lapping
NORTON: 2Fx40" dia., for flat work
SCHRANER: Model A External Cylindrical Lapper—4 heads

LATHES—PRODUCTION

BLOUNT: Polishing speed lathe 12" dia. x 48": centers
LODGE & SHIPLEY: No. 3A Duomatic, 27" center
MONARCH: 24"x60" Geared Head
MICHIGAN: 1708 Relieving, 8"x24"
MICHIGAN: 1712 Relieving, 12"x32"
MORANDO: New, all sizes from 17" to 42" swing
MORANDO: Relieving Lathes (New) two sizes
PRATT & WHITNEY: 16"x40" Toolroom

Lathes—Production—*Cont.*

WILLSON: 15" x 48" Geared Head Motor Driven (New)

LATHES—TURRET

GISHOLT: #2L Saddle Type
HERBERT: #8 for chuck work, 20" swing (New machines)
HERBERT: Turret Lathes, all sizes (New)
WARNER & SWASEY: 2A, Saddle Type
WEBSTER & BENNETT: Vertical Turret Lathes, 36" and 60" dia. (New)

MILLING MACHINES

BRIDGEPORT: Vertical Miller, power feed
CINCINNATI: 2-spindle Vertical Hydrotel with two rotary tables of 36" dia.
FICE-BARTON: Duplex Spline
SUNDSTRAND: No. 0 Rigidmil
TAYLOR-FENN: M-80 Duplex Spline
TAYLOR-FENN: Vertical 6"x21" table with power feed, high spindle speeds, for toolroom work
VAN NORMAN: 10CT Contour Miller, horizontal opposed spindle type for milling flat cams, also can be converted to similar work

SAWS & CUT-OFF MACHINES

CAMPBELL: No. 425 Cutalator Abrasive Cut-Off, 4½" dia. capacity
MOTCH & MERRYWEATHER: No. 3 Circular Saw with auto. stock feed
RUSSELL: 9½" cut-off Saw with Auto. Stock Feed (New) Hydraulic
WILLIAMS: 10" Pipe & Tube Cut-Off

THREAD MILLERS & TAPPERS

HALL PLANETARY: Model "D" Thread
LEES-BRADNER: LT 6"x36" Thread
LEES-BRADNER: 40A Thread Miller
MURCHEY: #22 Horizontal threading and tapping machine, ½" to 2½" dia. capacity
NATCO: Vertical Tapper 16 spindle
PRODUCTO: Hand Tapper

TOOL SHARPENERS

FELLOWS: Flat Top Helical Gear Cutter
OLIVER: #2 Face Mill Grinder
OLIVER: 10" Template Tool Bit Grinder
RANSOM: 2-Wheel Grinder 3 HP
RUSSELL: 40" Saw Sharpener (New), automatic indexing from tooth to tooth

MISCELLANEOUS

RUSSELL: 9½" cut-off Saw with Auto. Stock Feed (New) Hydraulic
CUT-OFF: Campbell, Abrasive 423 Cutalator, 4½" dia. capacity
CUT-OFF: Pipe & Tube, 10" Williams
PRESS: Screw, Gen. Flex. 3 ton
RIVETER: Gen. Engr. 24" throat
TEST STAND: Denison 918-AM Hyd.
LATHES: Blount Polishing Speed Lathe, 12" dia. x 48" centers
RACK CUTTING MACHINE: Sykes 24" to 36" length capacity (New)
PUNCH SHAPER: Sentinel Shrewbury, Thiel type design (New)

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TRIPLEX MACHINE TOOL CORP.

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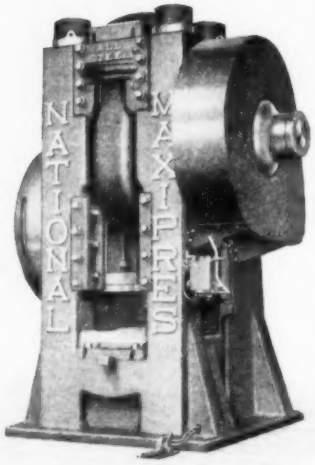
MACHINE TOOL ENGINEERS SINCE 1919

AVAILABLE IN STOCK
NATIONAL MAXIPRES



NATIONAL No. 2 MOTOR DRIVEN ALL STEEL-COINING MAXIPRES.
Capacity 500 Ton — Stroke 6"
Area of Bed L to R 20" — F to B 34"
1934 Machine — with 15 H.P. Motor

New, Used and Engineered Rebuilt Machine Tools

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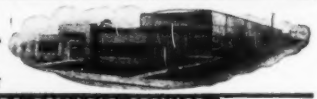

OVER FIFTY YEARS OF RELIABLE SERVICE

LATE MODEL TOOLS

BORING MILLS
#31 LUCAS Horizontal Boring, Drilling and Milling Machine, 3" bar
#25RT G&L Horizontal Boring, Drilling and Milling Machine
42" BULLARD Vertical Turret Lathes

LATHES
20"x8' AMERICAN Geared Head Lathe

AUTO. LATHES & TURRETS
#4 Gisholt Ram Type Turret Lathe
#5DE POTTER & JOHNSTON Aut. Turret Lathe
#6S POTTER & JOHNSTON Aut. Turret Lathe

MILLING MACHINES
#2HL K&T Plain Miller
#1M CINCINNATI Vertical Miller, 1941
#26 VAN NORMAN Ram Type Universal Miller
36"x36"x16" INGERSOLL Adjustable Rail Planer Type Miller, 40 HP AC motor drive, one rail head, two side heads
#0B CINCINNATI Plain & Vert. Aut. Millers

GRINDERS
6"x18" LANDIS Type C Plain Grinder
10"x18" LANDIS Type C Plain Grinder
6"x18" NORTON Vert. Spindle Surface Grinder
10"x72" LANDIS Type C, Hyd. Pl. Grinder, 1942
16"x96" LANDIS Type B Pl. Cyl. with Gap Bed
#16-28 BRYANT Hyd. Internal Grinder
#174 HEALD Hyd. Gap Internal Grinder
#73 HEALD Internal Centerless Grinder
#TG-18s JONES & LAMSON Internal Thread Grinder, new

DRILLS
#2LMS LELAND GIFFORD 2-spindle on 4-spindle base
#3MS LELAND GIFFORD 2-spindle, hyd. fd.
#42S BAKER S.S. Heavy Duty Drill
3'9" CARLTON Radial Drill, 1941

GEAR EQUIPMENT
#725A FELLOWS High Speed Gear Shaper
#36BM GOULD & EBERHARDT Gear Roughor
#12 FELLOWS Gear Shaver

MISCELLANEOUS
New #25-18 LITTELL Motor driven Automatic Centering Reel
36"x36"x10' CINCINNATI D.H. Planer, 3 heads, M.D.
15" BETTS Vertical Slotter
#1L LAPOINTE Hyd. Broach, 1945
16" GEMCO Shaper, M.D.
#½B P&W Two Spindle Reaming Machine, 1944
4½"x36" P&W Model C Thread Miller
Model H-I MICROMATIC Hydrohoner
6" TAYLOR & FENN Spline Millers
⅞" CONOMATIC 4-spindle Aut. Screw Machine
4⅝" CONOMATIC 4-spindle Auto. Screw Machine

WIGGLESWORTH INDUSTRIAL CORP.
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*PRACTICALLY NEW
BLISS NO. 26A KNUCKLE JOINT PRESS

Tie-rod frame construction. Arranged for dial feed. Bed area 36"x40". Stroke 5". Air operated friction clutch.

National Machinery Exchange, Inc.
138 Mott St. New York 13, N. Y.
CAnal 6-2470

READY TO SHIP
some of 'Rice's' Guaranteed Tools

SOME HEADLINERS ALL LIKE NEW

Brown & Sharpe #2 Universal Cylindrical Grinder, Internal spindle, (new 1942)
Heald #25A Rotary Surface Grinder, 24" Magnetic Chuck, (1941), Light Tool Room use
Gallmeyer & Livingston #3V Hydraulic Surface Grinder, 8"x24" capacity, (1940)
Leland Gifford #2LMS and 1LMS Prec. Drills
Pels #Mk10 Universal Ironworker
24"x24"x96" Liberty Planer, Box Table, D.C. Rev. Drive
Bertsch 36" Gap Punch; 1" thru 1¼" Cap., 10 N.P. M.D.
H-2 Micromatic Hydrohone, (1943)
CHUCKER, ACME GRID 4 Spindle 10" Mid R.L.B. (1937)
CLEVELAND Mod. DB Lead Screw 2" Tappers (1944)

Robert W. Rice and Company, Inc.
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FI 6-0782

FOR SALE
1—FEDERAL SPOT WELDING MACHINE

Type P-3-12-RA—AC-DC 440V, 50 cycle, 150 KVA, with; Ratheson Weld Power Supply Unit—Type S—220/440V.— 60 cycles, 3 phase, also control panel for seam welding Federal Transformer with Dial Control, also Frostbite Unit, Model #751 and one (1) Ignitron, G.E. Model FG—258A—Size D-5837. Originally purchased 1943—cost new $15,200.00. Selling Price $5,450.00.

Condition very good, sold as is—where is, Buffalo, N. Y. Subject to prior sale.

CORNELL AERONAUTICAL LABORATORY, INC.
BUFFALO 21, NEW YORK

MACHINERY FOR SALE

#1, #2 & #3 Warner & Swasey Turret Lathes, Late Type

Excellent Condition

FAIRFIELD EQUIPMENT CO.
100 Sanford St. at R.R. Station FAIRFIELD, CONN.

SOME LATE MACHINES STILL AVAILABLE

BORING MILLS

Bullard 24", VTL New Era
Cleveland 2½" Bar Cap.
Giddings & Lewis No. O, 3" cap.
Giddings & Lewis No. 32, 3¾" cap
King 42", 72" Vert. 2 rail heads
Niles-Bement-Pond 4" Bar
Niles-Bement-Pond 4½" Bar
Niles-Bement-Pond 60" Vert.

DRILLS AND RADIALS

Bausch Multi-spindle
American 6'x15" Univ.
Buffalo #2 Motor Spindle
Cincinnati Bickford 6'x13" col.
Walker-Turner Radial. 21½'
Natco #12 20 spindle drill

ENGRAVERS

Auto Engravers Bench Type
Deckel Type GK2 3 Dimensional, New
Gorton #1A, ME
Gorton #3B 3 Dimensional
Taylor and Hobson 3 Dimensional

GEAR EQUIPMENT

Barber-Colman #3, #2
Barber-Colman #12 Hobber (2)
Fellows High Speed Shapers 712, 725, 71
Flather 72" Cutter
Gleason 3" Straight Bevel Generator
Gleason #4 Angular Bevel Tester
Gleason #2 Surface Hardener
Gould & Eberhardt 36" Cutter
National Broach Red Ring Lapper, Shaver
Schuchardt & Shutte #1 Hobber
Fellows #20M Redliner

GRINDERS, MISCELLANEOUS

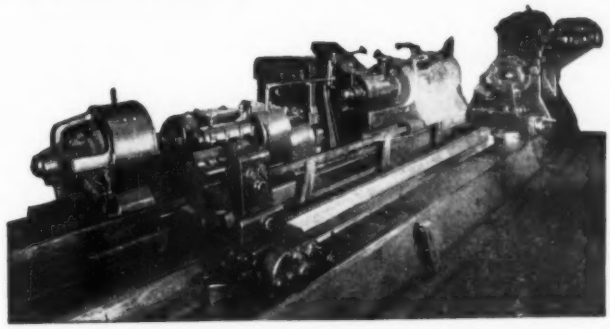
Bryant #5 Internal, chucking
Covel #91A Univ. Tool & Cutter
Grenby Int. 1G-12
Heald #73 Internal centerless
Heald #81 Internal Gagematic
Heald 72A3 Int. Centerless Sizematic, #1 Tool
Landis 12"x36" Univ., Latest
Landis 6"x30" Type C Cyl.
Majestic Internal
Norton Type C 6"x18" Semi-Automatic cyl.
Norton 6"x30", 10"x18" Type C cyl.
Norton 14"x96" cyl.
Norton 16"x48" Type C Univ.
Norton Roll Grinder 50"x28'
Oliver #510 Drill Pointer, Sellers 4G
Pratt & Whitney Radius #R6, K.O. Lee Tool
Van Norman #666 Crankshaft
Vernon Tool & Cutter
Wicaco Internal

GRINDERS, SURFACE

Abrasive 8x24", #33 Vert.
#10 Blanchard 16" Chuck
Blanchard #16, 30" Mag. Chuck
Brown & Sharpe #2 Mag. Chuck
G & L #45 12"x24" Hyd. Feed, #5, 10"x36"
Heald 22—12" chuck, Arter 12"
Pratt & whitney 12x36" Vert.
Reid 11x36 Motor In Base

LATHES

Bertram 28"x22' CC, Late.
Bridgeford 36"x20', 32"x16'.
Lodge & Shipley #3 Duomatics
Hardinge Precision 9", 1" Collet Cap., Rivett



Norton Roll Grinder 50" x 28' (actual photo)

Hendey 14" Yoke Head Lathes
LeBlond Regal 10"x3' bed
Lipe-Corbo 12"x18" (2)
Putnam 36"x22'
Putnam 42"x17'
Sebastian 12"x4' G.H.
Wickes 32"x35' Geared Head
Reid Small Piece #9WSL
Sundstrand 8x15"
Sundstrand 15" Stub

MILLS, PLAIN, UNIVERSAL & PROD.

Archdale Plain, 14", Prod.
Brown & Sharpe #000, 21
Burke #4 Plain & Univ.
Cinn. 08 Plain
No. 2, 3, 4 Plain Spd.
Cinn. 1-12 Mfg. 2-18
Kent Owens 1V
Millwaukee #2B, Plain & Univ.
Simmons Micro-Mill
Sundstrand 0, 00 Rigidmills
Van Norman #2 Universal

MILLS, VERTICAL

Brown & Sharpe #3 single pulley drive
Cincinnati #3, #4 hi-power
Cincinnati 08 Vertical
Morey #12M Profiler, 2 sp.
Pratt & Whitney Profiler 12B, 2 SP

PRESSES

Bliss 304A 4" Str.
Bliss 645, 650 Hi-Production Presses
Bliss 18, 21, OBI, 58, 62, 162 OB.
Bliss 4½ Double Action, Roll Feeds, Cam (2)
Bliss #78½, 330 Ton, SS, Bliss 74½
Ferracute EG54, 400 Ton Knuckle
Niagara Horning, 15 Ton
Niagara A1¾, O.B.I.
Toledo 400 Ton Knuckle Joint #663
Toledo 29 Double Action Cam
V. & O. #102 O.B.I. Reducing
Walsh No. 3 O.B.I. 23 Ton
Zeh & Hanneman 40 Ton OBI

TURRET LATHES

Acme 6W Fox 2 9/16" Cap.
Bardons & Oliver #2 Late, #3
Brown & Sharpe, #1, 2 Hand, #10, 11
Denver, 6 2" Shell Turret (2)
Foster #2B 2½" Cap.
Gisholt #4 bar feed, Late
Gisholt #2L Cross Sliding Turret
Hardinge second operation
Jones & Lamson 2½" Saddle Univ. Late
Morey #2G Late
Oster 601 WD. #2 Simmons Microspeed
Warner & Swasey #1A, 2A Timken Head
Warner & Swasey #5 Universal

MISCELLANEOUS

Automatic, Cleveland Model B 1 1/16"
Automatic B & S #00G

HYDRAULIC EQUIPMENT

SELF CONTAINED PRESSES

500 ton Shaft Straightener 24' Long Bed. Watson Stillman
125 Ton Southwark Press, Bed 96"x30". 30" stroke, 2 to 4 ft. opening
50 Ton William & White Gap Press, 20" St. 54"x20" Bed—24" opening
600 Ton William & White Up-Moving Ram 42"x60" platen 12" str., 24" opening self-contained.

MISCELLANEOUS PRESSES

300 Ton Watson Stillman 24x20" Platen 11" St. 21" opening

All Hydraulic Equipment is completely engineered and checked by a competent staff, thus assuring reliability. Send us your Hydraulic problems.

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Air Hydraulic Presses — Arbor Presses #6C Famco — Band Saws Kalamazoo — Famco 6x12"—Drill Presses all sizes—Hydraulic Press Northern 20 Ton—Injection Molders, 1 ounce—Power Presses, OBI, 1, 4, 4½, 5, 7½, 10, 15, 20, 30 ton —Shaper 7" Amco, 8" Shaperite—Shaper Sheldon 12"—Shears, Foot 22" to 8', 16 & 18 ga.—Shears, Power 3'x18 gauge to 10' x 10 ga.—Welders, Arc, Seam, Spot all sizes—Vert. Milling Attach. Halco H.S. Motors Grinders, Buffers, all sizes.

Automatic 4 Sp. 1½ Conomatic
Band Saw: DoAll Zephyr 36"
Band Saw: #8 Marvel
Filers—Grob Band Filer
Hacksaw: Peerless 6"x6"
Hacksaw: Racine 10x10" Hyd.
Honer: Micromatic #H-1
Keyseater: Davis, Baker, M & M
Shapers: 24" Rockford, 24" Cinci., 28" Gould & Eberhardt. Many Others
Shears Power: George Ohl 10'3/16", 10'x16 gauge, 11'x16 gauge
Tappers: #3C Haskins
Welder: 50 KVA Eisler Air Operated
Welder: Taylor-Winfield 50 KVA Hi-Wave

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⅞" Gridley Model G.
1¼" Cone 4 spindle
1½" Cone 4 spindle
No. 434 New Britain Chucking
14"x18" Monarch Magnamatics

BORING MILLS
84" Gisholt
34" King single turret
3" Rockford
4" Detrick & Harvey floor type
No. 5D Moline 6 spdl. cylinder bore

DRILLS
14" Leland Gifford 1, 2 & 4 spdl.
14", 4 spdl Buffalo sensitive
15", No. 2 Avey, 1 & 4 spdl., hydr. feed
16" Sipp, 2 spindle
24", No. 4B Edlund, power feed
24" Cincinnati
Nos. 310, 315 Baker
No. 217H Baker horizontal
Barnes horizontal radial
3' Carlton sensitive radial
6'-15" Dreses radial
14 spdl. No. E5 Natco (tapping)
16 spindle No. 13 Natco multiple
36 spdl. No. 2 Baush
1 & 4 spdl. Avey No. 2, woodpecker feed
7 spdl. Moline horiz. hydr.
12 spdl. Defiance adjustable rail
6 spindle Kent automatic
Several 2, 3 & 4 way Multiple with fixed center spindles

GEAR CUTTERS
14", No. 5A Lees Bradner hobber
24", No. 3 Adams Farwell hobber
Nos. 8H, 12H, 16HS, 18H G. & E.
No. 130 Cleveland Rigidhobber
No. 5A Lees Bradner hobber
4" Gleason spiral bevel
Gleason testers & lappers
Illinois involute tester
Red Ring shavers, lappers & speeders

GRINDERS, CYLINDRICAL
10"x18" Norton, plain & semi-auto.
10"x18" Landis hydraulic
10"x24" & 16"x72" Landis mechanical
10"x18", 10"x30" & 10"x50" Norton mech.

GRINDERS, INTERNAL
No. 75A Heald hand feed
Nos. 72A3 & 72A5 Heald
No. 72A3 Heald, cross sliding, head
No. 72A3 Heald Sizematic
Nos. 16-28 16F28 & 24-36 Bryant
Grenby bench type

GRINDERS, SURFACE
No. 10 Blanchard rotary
12" & 16", No. 22 Heald rotary
8" Pratt & Whitney rotary (tub)
14"x36" Pratt & Whitney vertical

MILLERS
No. 2 Cincinnati, horiz.
12" Cincinnati Plain Mfg.
18" & 24" Cincinnati plain automatic
No. 4-36 Cincinnati Hydromatic
18", 24" Cincinnati duplex
Nos. 1, 2 & 3 Kent Owens hand
No. 1 Kent Owens semi-automatic
30"x84" table Ingersoll vertical
Ingersoll Rise & Fall
6 spindle Moline profiler
24"x18"x14' Ingersol planer
48"x24"x22' Ingersoll planer
30" Newton rotary
30", 42" & 84" Ingersoll rotary
No. CT 36 Less Bradner thread
Nos. 4 & 6 Lees Bradner Univ. thread
4½"x12" & 6"x14" P&W thread

SHAPERS & PLANERS
24" Queen City Shaper
27 Morton Draw Cut Shapers
16" Bement Miles slotter
36"x36"x10' Betts planer

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FINE LATE TYPE GUARANTEED TOOLS

No. 2B FOSTER, Hardened Ways, Timken Spindle

No. 2 SIMMONS Micro-Speed Turret Lathe, bar feed, 3 jaw chuck, 4 jaw chuck, power feed to turret, tooling, coolant pump, AC motor

56"x18' CMC Heavy Duty Lathe, 24 speed geared head, power rapid traverse, 30HP AC motor

100" SELLERS Vertical Boring Mill, 2 swivel heads on rail, rapid traverse, 40HP motor drive, rebuilt, excellent

10'-16" CMC Heavy Duty Vertical Boring Mill, extension type, 2 swivel heads on cross rail, weight approx. 125,000#

100" BERTRAM (Niles Patterns) Vertical Boring Mill, 2 heads on rail, rapid traverse

24" BULLARD New Era Type Vertical Turret Lathe, side head, motor drive

No. 1 DOUGLAS Plain Horizontal Mill, table 8"x32", power feeds, motor in base, No. 40 taper, new 1942

No. 2D KEARNEY & TRECKER Rotary Head Die Miller, cherring attachment, right angle milling attachment, slotting attachment, rotary table, measuring rods, new 1943

No. 2V REED PRENTICE High Speed Vertical Mill & Router, new 1942

No. 2B KEARNEY & TRECKER Vertical, motor in base

No. 3 KEARNEY & TRECKER Vertical, No. 50 taper, motor in base

No. 3 KEARNEY & TRECKER Vertical, motor in base

No. 3 CINCINNATI Plain, motor in base, vertical head

No. 4 KEARNEY & TRECKER Plain, motor in base, vertical head

No. 4 CINCINNATI Plain, high power

No. 5 JOHNSON O.B.I. Press, new 1944, 55 tons

No. 6 TOLEDO O.B.I. Press, 70 tons

25A HEALD Rotary Surface Grinder, 24" diameter, magnetic chuck

V-6-24 COLONIAL Vertical Broach, 6 ton, 24" stroke, 1947

V-6-36 COLONIAL Vertical Broach, 6 ton, 36" stroke

36"x36"x10' GRAY Planer, DC reversing drive, box table, rapid traverse

No. 5 HILLES & JONES Pyramid Type Plate Bending Rolls, 14" diameter top roll, 12" diameter bottom roll, 10' long, drop end housing, 30 HP slip ring motors

No 60 NEW BRITAIN 1"—6 Spindle Automatic Screw Machine, new 1943

16HS GOULD & EBERHARDT Gear Hobber

36H GOULD & EBERHARDT Gear Hobber

O'CONNELL MACHINERY CO.
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MODERN MACHINES

#40 Landis Floor Type Horizontal Boring Mill
6D Potter & Johnson Automatic Chucking Machine
#35 Excello Thread Grinder
#61A Fellows Gear Shaper
#1A Warner & Swasey Turret Lathe
#30 Waterbury Farrell Thread Rollers
#0 Brown & Sharpe Automatic Screw Machines with Turner Drives
#3 Barber Coleman Hobbing Machine
G1-A Acme Gridley 1½ Automatic Screw Machine
#262 Barnes Camel Back Drill
16" Gould & Eberhardt Shaper
6 Spindle Allen Drill
22"x10' Centers Putnam Geared Head Gap Lathe

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350 Waterman St., Providence, R. I.

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Serial 4126 With 12" Bore oversized workhead, hand operated dial indicator for sizing. Capacity of work 10" O.D. and 32" in length. Workhead 35 to 105 RPM; 25 HP Wheelhead Motor, workhead cross travel 9" backward and 7" forward of centerline. Power feed adjustment each ratchet—coarse handwheel gears .0002"; with fine handwheel gears .000138"; main table feed hydraulic, complete with coolant system, diamond truing device, centering fixture, clamp jaws, end stops and two extra grinding spindles—electrical equipment 220 volt 60 cycle, 3 phase, except 5 HP workhead motor, 230 volt D.C.

This machine is in excellent condition having been employed for approximately 8 years in producing precision microfinish surfaces in pump liners.

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Cuts External and Internal Gears 18" P.D. 3" face. Max. helix angle 30°. Not used since 1945!

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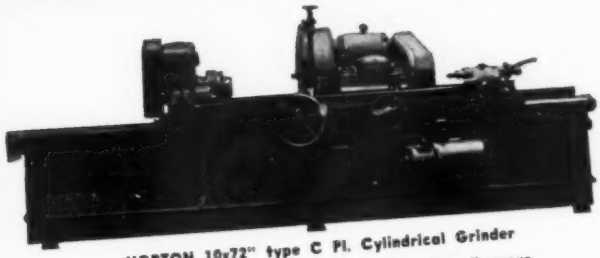

NORTON 10x72" type C Pl. Cylindrical Grinder

BORING MILLS—Horizontal

FRANKLIN 4¾" Bar; table type; M.D.
LANDIS #40, 4" Bar; floor type; M.D.
NILES 8" bar floor type, motor drive

BORING MILLS—Vertical

BULLARD 8", 16" 6-spdle. "A" Mult-au-matic
COLBURN 72"; power rapid traverse; M.D.
LANDIS No. 35 fl. type; 3½" bar; M.D.
NILES 53"; motor drive (heavy)

BROACHES

CINCINNATI 1-30 Duplex Vert. Hydr.
LaPOINTE S.R.V. 15-ton 48" Stroke, Late

DRILLS—Miscellaneous

BARNES No. 420 Deep Hole; late
BARNES H-3 Hydram; hydr.; Inverted; late
BARNES H-2 Hydram; hydr.; M.D.
BARNES 20" 4-spindle; Camel Back; Late
BARNES 24" all geared; Camel Back; M.D.
BODINE #42-20 multi-univ., dial feed; M.D.
MOLINE 6-spindle Hole-Hog 3⅝"; M.D.
NATCO No. 14 Mult.; Rect. Hd.; PRT; M.D.

GEAR CUTTING EQUIPMENT

BILGRAM 6" & 16" Bevel Gear Cutter, M.D.
BROWN & SHARPE #13 Spur Bevel Cutter
BROWN & SHARPE 6-72" Auto. Cutter; M.D.
CROSS #1, #40 Tooth Rounders; M.D.
FELLOWS No. 4 Eaveloping Gear Shaver; M.D.
FELLOWS Nos. 61A, 6Z2, 71S, 7S, 7, 7A, 75, 72, 77 High Speed Gear Shapers; late
FELLOWS 13-LS Lapper; late
GLEASON 8" & 12" Straight Bevel Gen.; late
GLEASON #4 and #6 Tester, Late Type
GLEASON 10", 11" & 18" Bevel Gear Gen.
GLEASON 24", 87", 77", 96" Bevel Gear Planers; M.D.
GLEASON No. 14 Hypoid Grinder; late
PRATT & WHITNEY 10" Gear Grinder; late
SYKES #4A, #8A gear generator; M.D.

GEAR HOBBERS

BARBER COLMAN #12 dble. overarm; M.D.
GOULD & EBERHARDT #24H, Late
GOULD & EBERHARDT No. 36H; Late
GOULD & EBERHARDT #36BM 3 spindle Auto. Rougher; M.D.
KOEFFER WM-11 Auto.; bench type; Late
PFAUTER RS1; max. dia. 30"; late

GRINDERS—Plain Cyl. & Univ.

CINCINNATI 6x18 cyl. Pl. Md.
CINCINNATI 14x48" Univ.; late
CINCINNATI 14x72 Model ER Plain, Late
LANDIS 10x36, 16x36 C Pl., Hyd., Late
LANDIS 4x18 type H; M.D.; late
LANDIS 6x18" Type C Plain; Hydr.; late
LANDIS 10x18" type C plain Hydr. M.D.
LANDIS 18x72" Type C; Hydr.; M.D.; Late
LANDIS 29"x130" centers Plain; M.D.
NORTON 6x30 plain; motor drive
NORTON 10x72" type C Plain; Late
NORTON 17x42" centers crankpin; Hydr. Dble. hd.; M.D.

GRINDERS—Surface

BROWN & SHARPE No. 5; motor drive
BILLITTER & KLUNZ 48x196" Way Grinder,
HEALD #22 Rotary, Late Type
HEALD #25A Rotary, Motor Drive
PRATT & WHITNEY 14x36" Model B, Late
TAFT PIERCE 6" Rotary, M.D.

GRINDERS—Miscellaneous

BRYANT No. 3, 5, 16-C-16, 16CP-16, 24 Intl. Hydr.; Late
COVEL #6 Univ. & Tool; NEW
EXCELLO #48 Carbide
GLEASON No. 12 Tool Sharpener; late
HEALD No. 81 "Sizematic"; Late
HEALD No. 72-A-5 "Gagematic" Int.; Late
HEALD No. 78 Internal Centerless; M.D.
LEMPCO 22x72" Mod. KG Crankshaft; Late
VAN NORMAN 666 Crankshaft Regrind
VAN NORMAN 639 Osc. type Radius; Late

LATHES—ENGINE & MFG.

AMERICAN 25"x220" centers; Timken; Late
AMERICAN 36"x360" centers; 2 carringes
AMERICAN 36"x33' centers geared; heavy
JONES & LAMSON "FAY" 20x28" Automatic; M.D.; Late
LEHMANN 25x96" cntr.; TIMKEN; grd M.D.
LeBLOND 16x36" cent.; Auto.; Timken; late
LeBLOND Mod. 7ACL Crankshaft; M.D.
LODGE & SHIPLEY 24x120" centers, Late
LODGE & SHIPLEY No. 5—24" and 96" centers DUOMATIC; Timken; Late
LoSWING 4x80", 8x24", 8x108"; late
MONARCH 14x42" centers "Z" Magnamatic Auto.; TIMKEN; M.D.; Late
MONARCH 22"x456" Centers "CM" Precision; helical geared; TIMKEN; M.D.
NILES 36"x50' Boring "Time-Saver"; Timken; Late
NILES 48"x32' centers Engine; geared; M.D.
REED PRENTICE 16"x24" centers grd; M.D.
SPRINGFIELD 14"x43", geared; M.D.

LATHES—TURRET

MOREY No. 2 ram type TIMKEN
WARNER & SWASEY No. 4; bar; M.D.; Late

MILLING MACHINES—Plain

CINCINNATI 0-8; M.D.; Late
CINCINNATI 4-48, 4 spindle, Tracer; Late
CINCINNATI 2-24 Timken; Late
CINCINNATI No. 3 Plain; rectangular, M.D.
SUNDSTRAND No. 3 Rigidmill; TIMKEN

MILLING MACHINES—MFG.

CINCINNATI #24 Duplex; SPD
GOULD & EBERHARDT 25 Cont. type; M.D.
INGERSOLL 32x24x16' Planer Type; 2 hds.
INGERSOLL 80x24x12' Adj. Rail Slab; M.D.
SUNDSTRAND Mod 3A Duplex 42" feed M.D.
TAYLOR & FEN M-80 Duplex Spline; Late

MILLING MACHINES—Universal

VAN NORMAN No. 36; M.D.; Late type

MILLING MACHINES—Vertical

CINCINNATI 0-8 Mod EA Auto. PRT; Late

MILLING MACHINES—Thread

HALL Style D Planetary, Late Type
LEES BRADNER HT 12", 54", M.D.; Late
MOREY 12x30", 12x60" centers; late
PRATT & WHITNEY 4½x12 Mod. C; late
PRATT & WHITNEY 6x132; M.D.

PLANERS

BETTS CONSOLIDATED 84"x92"x16' 4 heads PRT Box Table; DC Reversing M.D.
BETTS CONSOLIDATED 108"x84"x44' 4 heads; PRT; Box Table; M.D.
CLEVELAND 48"x48"x12' Openside; AC; M.D.
DETRICK & HARVEY 48"x48"x16' hydr.
LIBERTY 48"x48"x16' 4 hds. Double housing; vari-voltage
NILES 108"x84"x42' 4 heads; Rapid Traverse; Box Table DC; M.D.
NILES-BEMENT-POND 72"x72"x30' 4 hds.; Rapid Traverse; M.D.
SELLERS 60"x60"x12' 4 heads vari-voltage dr.; PRT
WOODWARD & POWELL 54"x54"x20'; 4 heads; M.D.

SAWS

ESPEN LUCAS No. 670-30' cap Hydr.; Late
HELLER Model SS-1, 6¾" Cap Cold Saw

SCREW MACHINES AUTOMATIC

NEW BRITAIN GRIDLEY Model 65 6 Spindle Chucker, Late
BROWN & SHARPE 00G High Speed, Late
GYROMATIC Model 40 1⅝" 6 Spindle, Late

SHAPERS—SLOTTERS

CINCINNATI 16", Heavy; PRT; Late
DILL 18" Slotter; motor drive
LeMAIRE 18" Vertical Hydraulic; Late
PRATT & WHITNEY 6" Vertical; M.D.

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LYND FARQUHAR 26" Openside; M.D.
NEWTON 15" Slotter; M.D.
ROCKFORD 20" vertical, Hydr.; Late

PRESSES

BESCO Mod. 21 Invl. 40 ton, 3" stroke NEW
BIRDSBORO 325 ton Vert Hydr; Late
BLISS No. 410A Toggle Drawing; tie rod; steel gearing
BLISS No. 3½A geared toggle; dble. acting
CHAMBERSBURG Straightening, 24"; M.D.
GLEASON 15", 25" Quenching; hydr.; M.D.
NATIONAL #5 H.S. Maxi-press (Forging)
NIAGARA No. 512 DG tie rod; 282 tons; M.D.
UNITED ENG. 500 ton hydr. forging
WATERBURY Farrel 125 Ton; SL Side

MISCELLANEOUS

ACME 2" forging, upsetting; late
AJAX 3½" forging, upsetting; M.D.
BAKER #5 Keyseater; motor drive
BARNES No. 172, 214 Honing; hydr.; Late
DeLAVAL No. 194 Coolant Clarifier; Late
FISCHER No. 1, No. 2 Oil Groover; Late
GROB OS-20 Metal Band Saw—Filer; M.D.
GROB NS-24 Band Saw; M.D.; Late
LANDIS 2" egle. Dble. Spdle. Threaders; M.D.
LeBLOND #2 Barrel Lapper; M.D.; Late
MANVILLE 2C Auto Screw Slotter; M.D.
MANVILLE No. 2 Slotters; Late
MANVILLE No. 3 Trimmers; Late
MANVILLE No. 2 DSOD Readher; M.D.
MANVILLE 1A DSSD Heater; M.D.
MANVILLE No. 3 Rehsaders; Late
MANVILLE No. 3C Thread Roller; M.D.
NORTON 2F, 26F Lapping Machines; Late
SAUNDERS 8-18" Pipe Machine; M.D.
US TOOL 810-B Cutter Reliever; Late
WATERBURY FARREL No. 11 Thread Roller

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BORING MILLS

EXCELLO Type DB2112 Two Spindle Borematic—hydraulic system—motor and heads—late type

HEALD #47A Boramatic—hydraulic crossfeed—three heads—late type

NILES 53" Vertical Boring Mill—2 swivel heads—power rapid traverse—4-Jaw chuck table—motor driven

BULLARD 54" "New Era" Vertical Boring Mill—side head—4-Jaw chuck—table—M.D.

GRINDERS

CINCINNATI 6" x 30" Plain Hydraulic Grinder—oscillating spindle—auto. infeed—4-Motor drive—1944 machine

LANDIS 6" x 18" Type "C" hydraulic Cylindrical Grinder—4-Motor drive—power rapid traverse—late type

NORTON 24" x 240" Type "A" Cylindrical Grinder—work and roll rests

GRENBY Type SG-1 Production Surface Grinder—magnetic chuck 18" dia.—stepless variable wheel speeds 1000 to 3000 RPM—MD—late type

ABRASIVE #3B Surface Grinder—cap. 8" x 24"—late type

NORTON 26" x 84" Crankshaft Grinder—1943 machine

LATHES

LODGE & SHIPLEY 24" x 12' Selective Geared Head Engine Lathe—taper attch.—threading dial—MD

NILES 48' x 30' ctrs. Geared Head—2 carriages—taper attachment—power rapid traverse—MD

FOSTER #2FU Fastermatics (2)—cap. 3"—lge. ass't. tooling—1943 and 1945 machines—used only a few months

BROWN & SHARPE #2 Hand Feed Screw Machine—1" cap.—collets—stock stand—late type

MILLERS

CINCINNATI 24" Auto. Duplex—#50 taper—tbl. 35¼" x 9½"—spdl. speeds to 603 RPM—M.D.

CINCINNATI #0-8 Plain Auto. Miller—rise & fall spdl. carrier—tbl. wkg. surface 18¼" x 6½"—late type

(New) INDUMA #2A Univ.—range 24" x 9" x 17"—vert. hd.—univ. dividing head

BROWN & SHARPE #3A Constant Spd.—dividing head—range 34" x 12" x 19"—MD

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10" Gridley 4 Spindle Chucker
8" Cleveland 4 Spindle Chucker
Parker Tube Bender
6C Potter & Johnston Lathe
6D Potter & Johnston Lathe
No. 3XA Oilgear Horiz. Hydraulic Broach
No. 3 Barber Colman Gear Hobbers (5)
30" Colburn Vertical Boring Mill
Hanchett No. 221 opposed Disc Grinder
No. 24-26 Bryant Internal Grinder, 1941
4"x12" Landis Type H Grinder, 1940
Model GG36 Geargrind Grinder, 1943
No. 73 Heald Internal Grinder, 1942
Cincinnati Monoset Tool & Cutter Grinder, '42
Detroit Model DH2 Brinell Tester
D-1 Colburn Heavy Duty Drill
Moline 6 Spindle Rail Drills
6A Potter & Johnston Turret Lathes
4FU Foster Fastermatic Turret Lathe
10" Hole Steinle Turret Lathe
Bridgeport Duplex Automatic Mill—1944
Sundstrand Vertical Mill, rotary table
16" Kearney & Trecker Face Mill Grinder—1942
No. 3S Cincinnati Universal Mill
36A Hanchett Rotary Grinder—1942
No. 1 to 4 Consolidated O.B.I. Presses
No. 304 Bliss Straight Side Press—1942
Erco Model 1002 Riveters 48" Throat—1943
Erco Model 279 Riveters 36" Throat—1943
No. 6 Fellows Gear Shaper
8" Sundstrand Stub Lathe
4A Warner & Swasey Turret Lathe
Model U Lo Swing Lathe, 1942
No. 3 S.S. Leland Gifford Drill

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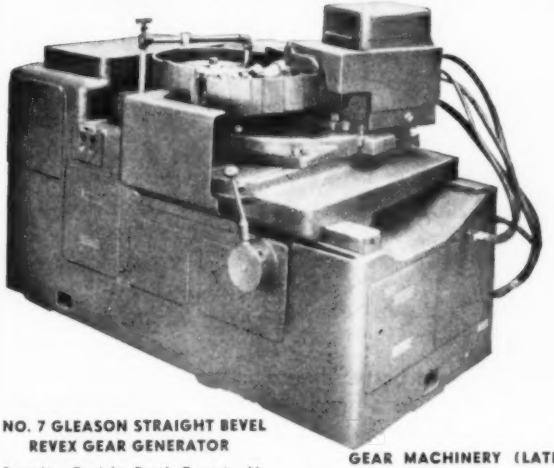

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Max. pitch dia. int. spur or helical 6"
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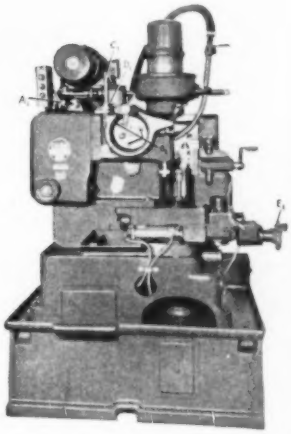

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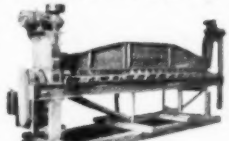

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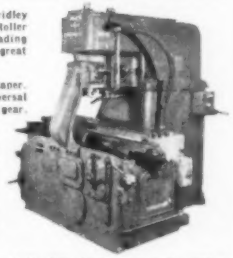

3-36 Cinc. Vert. Hydromatic Mill 2 spindle. Machine new 1943. Table size 12"x50". 36" table travel. 6" vert. adj. of spindles. Inside spindle overhang 8". Outside spindle overhang 17¾".

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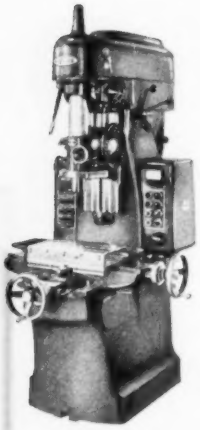

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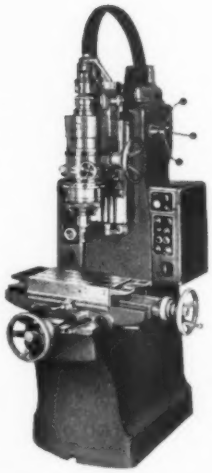

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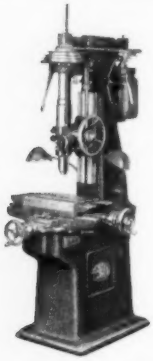

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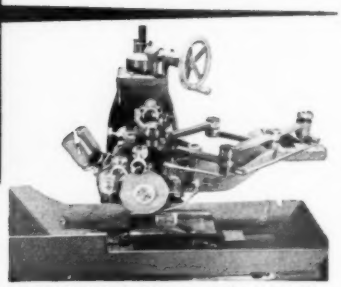

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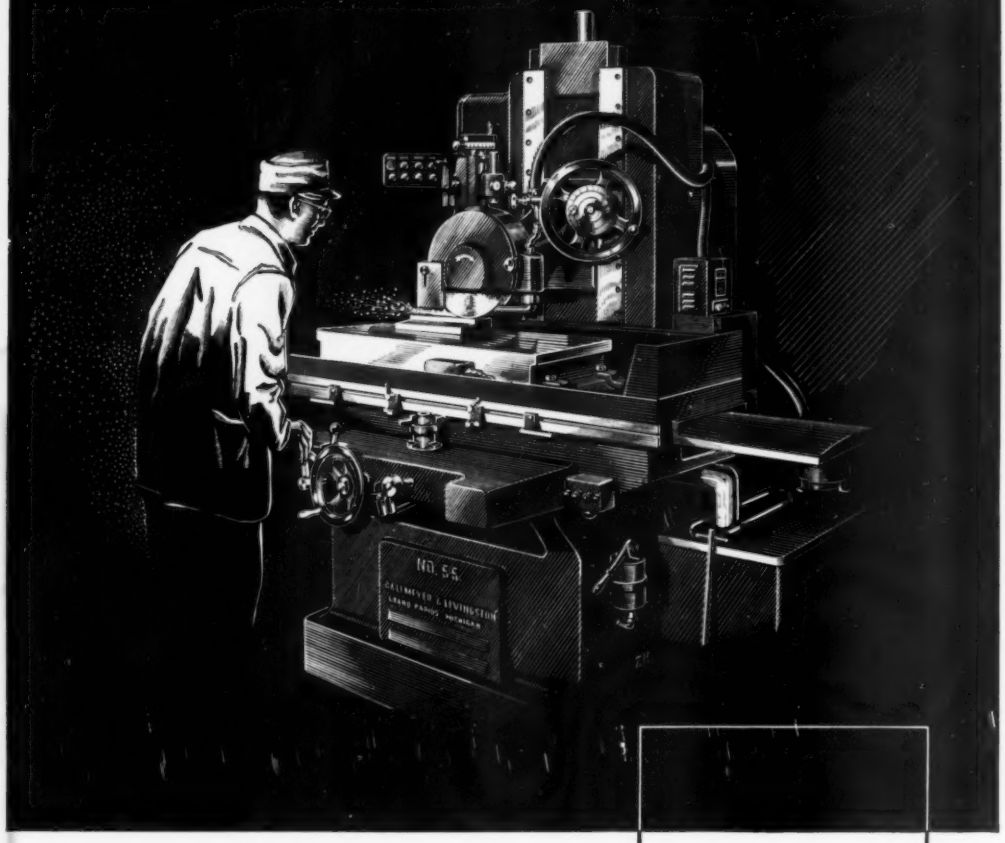

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In the plant of a leading automobile manufacturer, the 2000 ton Verson Knuckle Joint Press illustrated stamps out automatic drive flywheels at the rate of 260 per hour. A flat blank is transformed into a flywheel ready for machining in a single operation in less than 14 seconds!

The acceptance of press forming of precision parts under tremendous force is growing rapidly. By using the knuckle joint's characteristic of applying high pressure over a concentrated area it is often possible to produce superior quality parts at a substantially higher rate and at a fraction of the cost of conventional methods.

Verson Knuckle Joint Presses meet all requirements for work of this type. Their rugged, all steel construction in combination with Verson design gives them the accuracy, power, speed and dependability so vital to this type of service. Write for complete details outlining the nature of your problem.

Originators and Pioneers of Allsteel Stamping Press Construction

VERSON ALLSTEEL PRESS COMPANY

9316 South Kenwood Avenue, Chicago 19, Illinois — So. Lamar at Ledbetter Dr., Dallas 15, Texas

A VERSON PRESS FOR EVERY JOB FROM 60 TONS UP

MECHANICAL AND HYDRAULIC PRESSES AND PRESS BRAKES • TRANSMAT PRESSES • TOOLING
DIE CUSHIONS • COMPRESSION AND TRANSFER MOLDING PRESSES

THE NEW BRITAIN MACHINE COMPANY

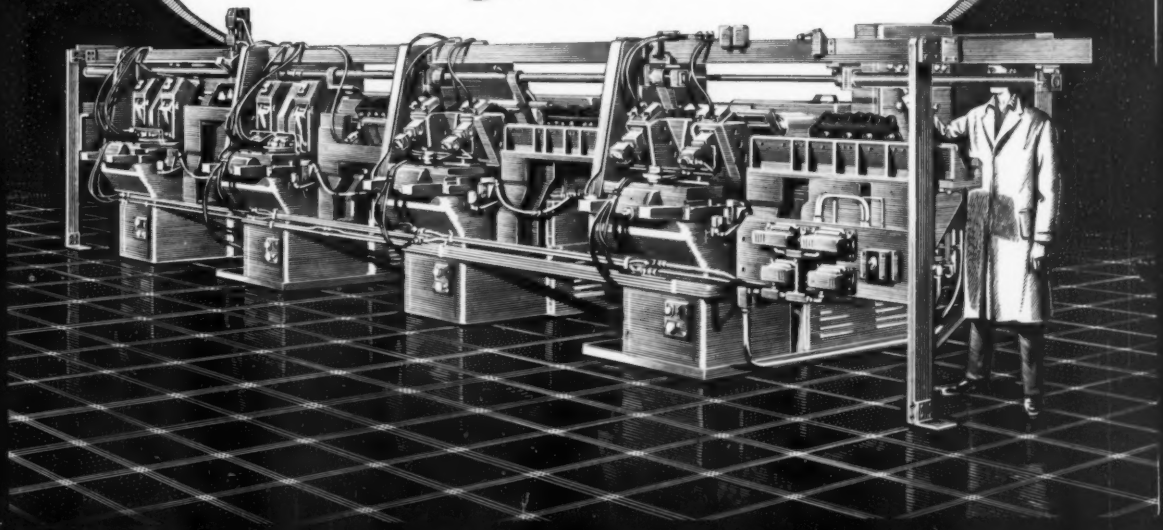
NB

What names come to your mind when you think of progressive manufacturing?

MOST of the ones you think of first have bought New Britain Automatics within the past few years for new and better ways of doing important metalworking jobs. The New Britain-Gridley Machine Division, The New Britain Machine Company, New Britain, Conn.

AUTOMATIC BAR AND CHUCKING MACHINES • PRECISION BORING MACHINES
LUCAS HORIZONTAL BORING, DRILLING AND MILLING MACHINES

NEW BRITAIN
Automatics



Production stamina, tool-room accuracy ..lathe gets both with TIMKEN® bearings

THIS "Economy" lathe is designed to fill a specific demand for a medium-priced lathe which has these two qualities: ruggedness for general production work and accuracy for tool-room service. To insure these two qualities, Rockford Machine Tool Co. mounts the spindle and gear shafts on Timken® tapered roller bearings.

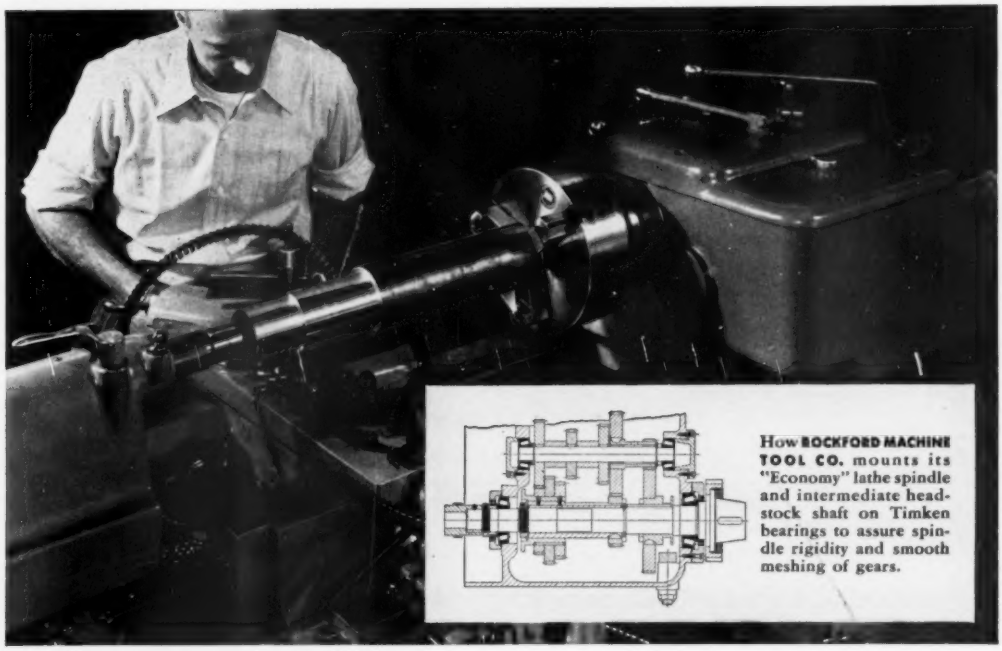
With Timken bearings, the spindle is held in rigid alignment. Precision is maintained. Gears mesh smoothly — with minimum wear even under the heaviest loads.

Because of their tapered construction, Timken bearings take radial and thrust loads in any combination. Line contact between rollers and races provides extra load-carrying capacity. The true rolling motion and incredibly smooth surface finish of Timken bearings practically eliminate friction.

Timken bearings hold shaft and housing concentric, making closures more effective. Because they are (1) precision manufactured, (2) engineered for the job, (3) made of Timken fine alloy steel, Timken bearings normally last the life of the machine.

When you buy or build machine tools, be sure they are equipped with Timken bearings. No other bearing can give you all the advantages of the Timken bearing. Look for the trade-mark "Timken". The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ont. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



How **ROCKFORD MACHINE TOOL CO.** mounts its "Economy" lathe spindle and intermediate headstock shaft on Timken bearings to assure spindle rigidity and smooth meshing of gears.

FINISHED TO CLOSER TOLERANCES

Finishing to incredible smoothness accounts for much of the precise, smooth rolling performance of Timken bearings. This honing operation is typical of the amazingly accurate manufacturing methods of the Timken Company.

The Timken Company is the acknowledged leader in: 1. advanced design; 2. precision manufacturing; 3. rigid quality control; 4. special analysis steels.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL ▯ AND THRUST ↔ LOADS OR ANY COMBINATION ✳